Power System Analysis

- Ashanti 11kV -

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	KONONGO
Feeder Name	AGOGO

: Input data in colored cells

Type-3

Maximum Current I_{max}
95.0A

<Trank Line 1>

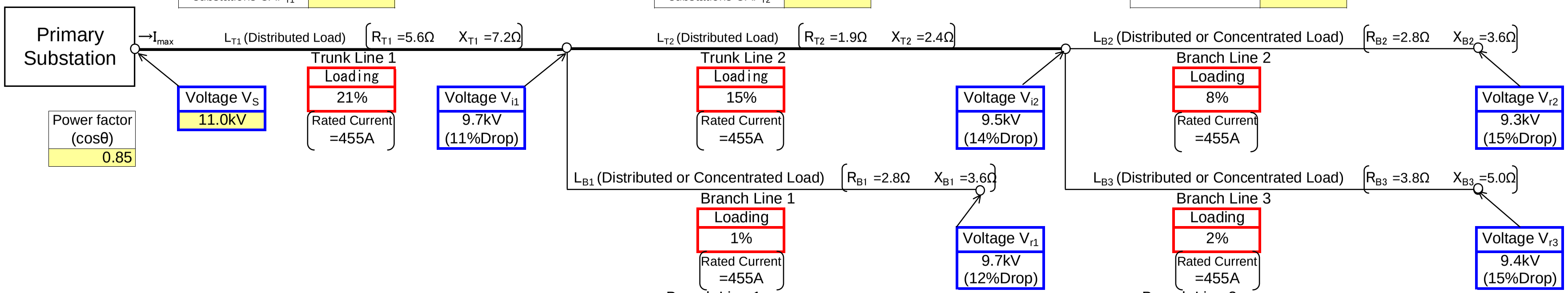
Load L_{T1}	21A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	20.3km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	1150kVA	

<Trank Line 2>

Load L_{T2}	20A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	6.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1115kVA	

<Branch Line 2>

Load L_{B2}	37A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	10.1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	2050kVA	



<Branch Line 1>

Load L_{B1}	5A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	10.1km	
Type of Distributed Load	Middle Smaller	
Total Transformer Capacity of secondary substations CAP_{B1}	300kVA	

<Branch Line 3>

Load L_{B3}	11A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	13.9km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B3}	600kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage
V_{i1} : Interim Voltage
V_{i2} : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
V_{r3} : Received Voltage

I_{max} : Maximum Current
L_{T1} : Load (Trunk line 1)
L_{T2} : Load (Trunk line 2)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
L_{B3} : Load (Branch Line 3)

$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
$CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3}$: Total Transformer Capacity of secondary substations
cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN C
Feeder Name	AIRPORT 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
365.0A

Power factor (cosθ)
0.82

<Trank Line 1>

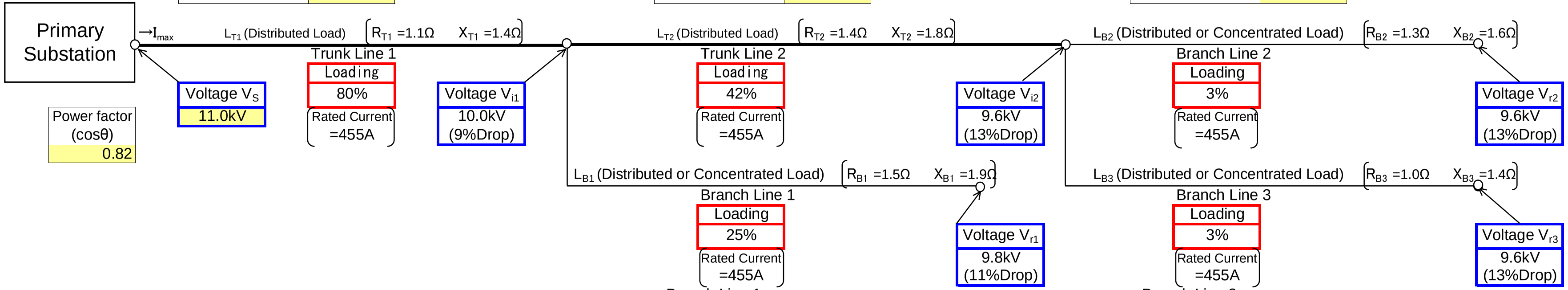
Load L_{T1}	61A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4.0km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2030kVA	

<Trank Line 2>

Load L_{T2}	161A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	5.1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	5330kVA	

<Branch Line 2>

Load L_{B2}	14A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	4.6km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	450kVA	



<Branch Line 1>

Load L_{B1}	113A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	5.4km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	3740kVA	

<Branch Line 3>

Load L_{B3}	15A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	3.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	500kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN C
Feeder Name	AIRPORT 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
405.0A

Power factor (cosθ)
0.82

<Trank Line 1>

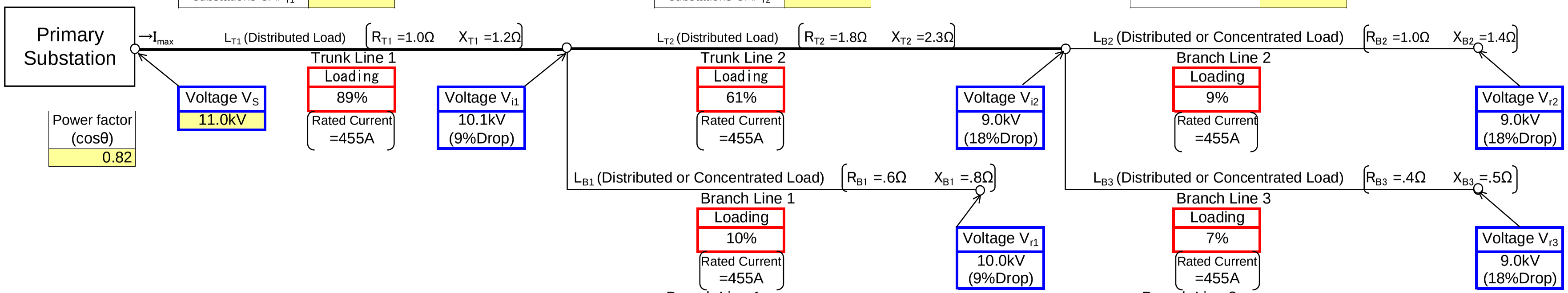
Load L_{T1}	84A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3.5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2600kVA	

<Trank Line 2>

Load L_{T2}	206A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	6.5km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T2}	6425kVA	

<Branch Line 2>

Load L_{B2}	39A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	3.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	1215kVA	



<Branch Line 1>

Load L_{B1}	44A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	2.2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	1365kVA	

<Branch Line 3>

Load L_{B3}	32A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	1.3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	1000kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	MAIN B
Feeder Name	B 11

: Input data in colored cells

Type-3

Primary Substation

Maximum Current I_{max}
335.0A

Power factor (cosθ)
0.97

$\rightarrow I_{max}$

<Trank Line 1>

Load L_{T1}	28A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	1.1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	630kVA	

L_{T1} (Distributed Load) (R_{T1} =.2Ω X_{T1} =.1Ω)

Trunk Line 1: Loading 100% (Rated Current =335A)

Voltage V_S: 11.0kV

Voltage V_{i1}: 10.9kV (1%Drop)

<Trank Line 2>

Load L_{T2}	132A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2.6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2945kVA	

L_{T2} (Distributed Load) (R_{T2} =.7Ω X_{T2} =.9Ω)

Trunk Line 2: Loading 74% (Rated Current =455A)

Voltage V_{i2}: 10.6kV (4%Drop)

<Branch Line 2>

Load L_{B2}	55A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	3.1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	1230kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =.9Ω X_{B2} =1.1Ω)

Branch Line 2: Loading 12% (Rated Current =455A)

Voltage V_{r2}: 10.6kV (4%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =.4Ω X_{B1} =.5Ω)

Branch Line 1: Loading 13% (Rated Current =455A)

Voltage V_{r1}: 10.9kV (1%Drop)

<Branch Line 1>

Load L_{B1}	59A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	1.4km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	1315kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =.8Ω X_{B3} =1.0Ω)

Branch Line 3: Loading 13% (Rated Current =455A)

Voltage V_{r3}: 10.5kV (4%Drop)

<Branch Line 3>

Load L_{B3}	61A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	2.8km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B3}	1350kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$,
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ : Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	MAIN B
Feeder Name	B 21

: Input data in colored cells

Type-3

Maximum Current I_{max}	190.0A
Power factor (cosθ)	0.97

<Trank Line 1>

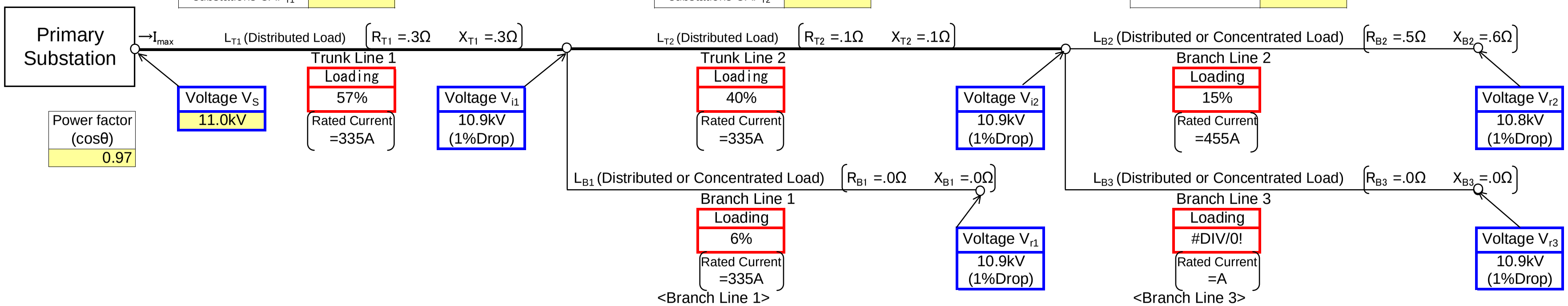
Load L_{T1}	34A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	2.2km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	500kVA	

<Trank Line 2>

Load L_{T2}	67A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	.4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1000kVA	

<Branch Line 2>

Load L_{B2}	68A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	1.8km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	1015kVA	



<Branch Line 1>

Load L_{B1}	21A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	.2km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B1}	315kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Line Length Len_{B3}	.0km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN B
Feeder Name	B 31

: Input data in colored cells

Type-2

<Trank Line>

Load L_T	30A
Line Type	185ALXPLE(11kV) No.24
Line Legth Len_T	.8km
Type of Distributed Load	Sending Larger
Total Transformer Capacity of secondary substations CAP_T	800kVA

<Branch Line 1>

Load L_{B1}	60A
Line Type	185ALXPLE(11kV) No.24
Line Length Len_{B1}	2.3km
Type of Distributed Load	Equality
Total Transformer Capacity of secondary substations CAP_{B1}	1600kVA

Maximum Current I_{max}	107.0A
Power factor (cosθ)	0.97

Primary Substation →I_{max}

Voltage V_S: 11.0kV

L_T (Distributed Load) (R_T =.1Ω X_T =.1Ω)

Trunk Line — Loading: 32% (Rated Current =335A)

Voltage V_i: 11.0kV (0%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =.3Ω X_{B1} =.3Ω)

Branch Line 1 — Loading: 18% (Rated Current =335A)

Voltage V_{r1}: 11.0kV (0%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =.4Ω X_{B2} =.2Ω)

Branch Line 2 — Loading: 7% (Rated Current =260A)

Voltage V_{r2}: 11.0kV (0%Drop)

<Branch Line 2>

Load L_{B2}	18A
Line Type	AAC50mm2 No.11
Line Length Len_{B1}	.6km
Type of Distributed Load	Sending Larger
Total Transformer Capacity of secondary substations CAP_{B2}	475kVA

=====Equation=====

$V_i = V_S - 1.732 \cdot (R_T\cos\theta + X_T\sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage
V_i : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
I_{max} : Maximum Current
L_T : Load (Trunk line)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
R_T, R_{B1}, R_{B2} : Resistance
X_T, X_{B1}, X_{B2} : Reactance
cosθ : Power Factor
f_T, f_{B1}, f_{B2} : Dispersal Load Factor
CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN B
Feeder Name	B41

: Input data in colored cells

Type-3

Maximum Current I_{max}	
110.0A	

Power factor (cosθ)	
0.97	

Primary Substation →I_{max}

<Trank Line 1>

Load L_{T1}	8A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	.6km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T1}	300kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	.3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	81A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	1.7km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	3065kVA	

L_{T1} (Distributed Load) (R_{T1} =.1Ω X_{T1} =.1Ω)
Trunk Line 1: Loading 33% (Rated Current =335A)
Voltage V_S: 11.0kV
Voltage V_{i1}: 11.0kV (0%Drop)

L_{T2} (Distributed Load) (R_{T2} =.0Ω X_{T2} =.0Ω)
Trunk Line 2: Loading 27% (Rated Current =335A)
Voltage V_{i2}: 11.0kV (0%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =.3Ω X_{B2} =.2Ω)
Branch Line 2: Loading 24% (Rated Current =335A)
Voltage V_{r2}: 10.9kV (1%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =.1Ω X_{B1} =.1Ω)
Branch Line 1: Loading 4% (Rated Current =335A)
Voltage V_{r1}: 11.0kV (0%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =.1Ω X_{B3} =.1Ω)
Branch Line 3: Loading 2% (Rated Current =455A)
Voltage V_{r3}: 11.0kV (0%Drop)

<Branch Line 1>

Load L_{B1}	13A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	.5km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B1}	500kVA	

<Branch Line 3>

Load L_{B3}	8A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	.4km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B3}	315kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN B
Feeder Name	B 71

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	134A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3.3km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	3160kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	.4km	
Type of Distributed Load		
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	212A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	7.1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	4985kVA	

Maximum Current I_{max}	400.0A
Power factor (cosθ)	0.97

Primary Substation →I_{max}

Voltage V_S: 11.0kV

L_{T1} (Distributed Load) (R_{T1} =.9Ω X_{T1} =1.2Ω)

Trunk Line 1 — Loading 88% (Rated Current =455A)

Voltage V_{i1}: 10.3kV (6%Drop)

L_{T2} (Distributed Load) (R_{T2} =.1Ω X_{T2} =.1Ω)

Trunk Line 2 — Loading 52% (Rated Current =455A)

Voltage V_{i2}: 10.3kV (7%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =1.9Ω X_{B2} =2.5Ω)

Branch Line 2 — Loading 47% (Rated Current =455A)

Voltage V_{r2}: 9.8kV (11%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =.1Ω X_{B1} =.1Ω)

Branch Line 1 — Loading 8% (Rated Current =335A)

Voltage V_{r1}: 10.3kV (6%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =.1Ω X_{B3} =.1Ω)

Branch Line 3 — Loading 8% (Rated Current =335A)

Voltage V_{r3}: 10.3kV (7%Drop)

<Branch Line 1>

Load L_{B1}	27A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	630kVA	

<Branch Line 3>

Load L_{B3}	27A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B3}	.7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	630kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN B
Feeder Name	B 61

: Input data in colored cells

Type-3

Maximum Current I_{max}
344.0A

<Trank Line 1>

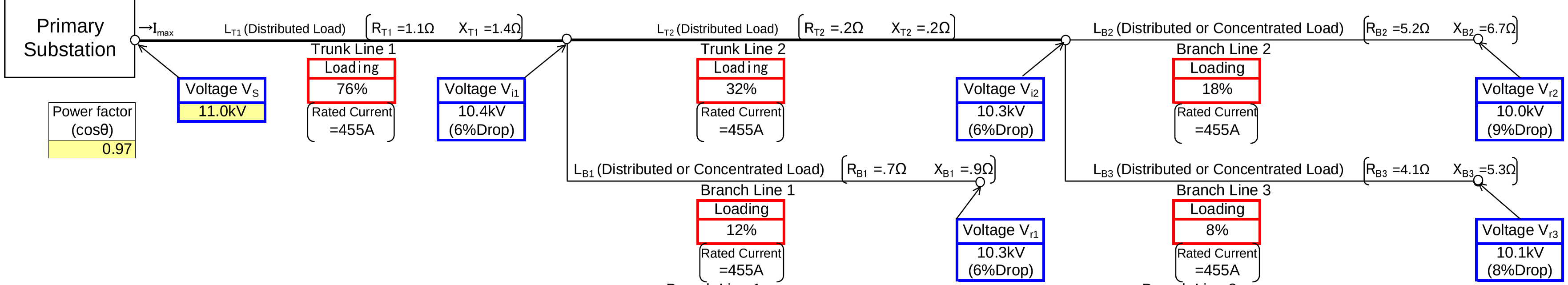
Load L_{T1}	143A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3.9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	4010kVA	

<Trank Line 2>

Load L_{T2}	31A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	.7km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T2}	880kVA	

<Branch Line 2>

Load L_{B2}	81A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	18.8km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	2270kVA	



Power factor (cosθ)
0.97

<Branch Line 1>

Load L_{B1}	53A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	2.4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	1500kVA	

<Branch Line 3>

Load L_{B3}	36A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	14.9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	1000kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN B
Feeder Name	B 81

: Input data in colored cells

Type-3

Maximum Current I_{max}
350.0A

Power factor (cosθ)
0.97

<Trank Line 1>

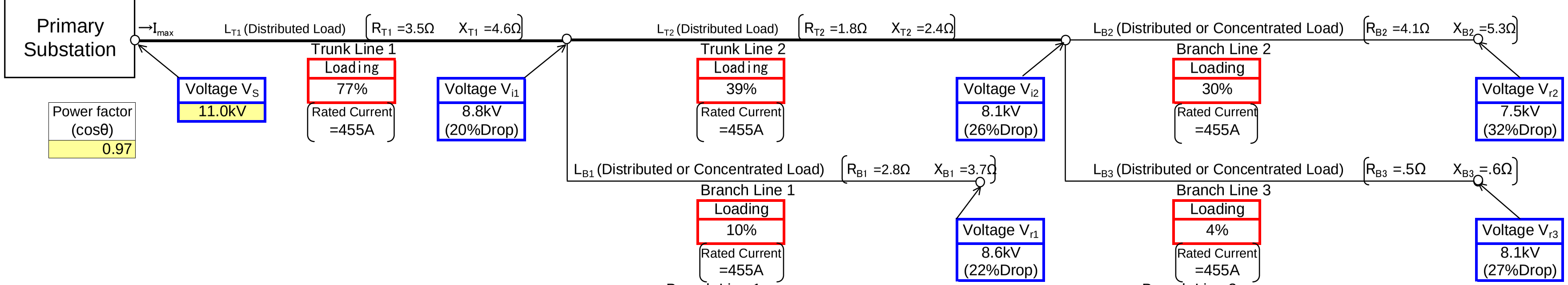
Load L_{T1}	129A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	12.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	8045kVA	

<Trank Line 2>

Load L_{T2}	21A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	6.6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1340kVA	

<Branch Line 2>

Load L_{B2}	136A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	14.9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	8495kVA	



<Branch Line 1>

Load L_{B1}	44A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	10.3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	2755kVA	

<Branch Line 3>

Load L_{B3}	19A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	1.7km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B3}	1200kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	KUMAWU
Feeder Name	BODOMASE

: Input data in colored cells

Type-3

Maximum Current I_{max}
19.0A

Power factor (cosθ)
0.82

<Trank Line 1>

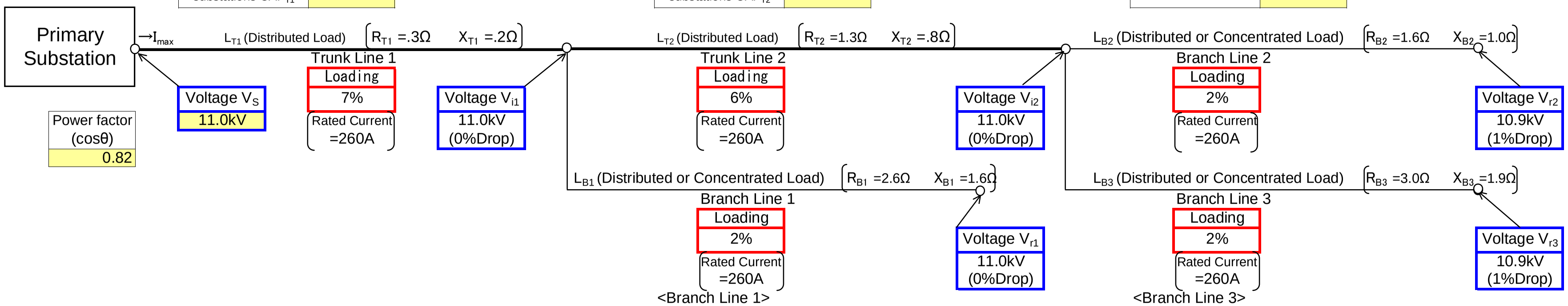
Load L_{T1}	A	
Line Type	AAC50mm2	No.11
Line Legth Len_{T1}	.5km	
Type of Distributed Load		
Total Transformer Capacity of secondary substations CAP_{T1}	kVA	

<Trank Line 2>

Load L_{T2}	6A	
Line Type	AAC50mm2	No.11
Line Legth Len_{T2}	2.1km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T2}	200kVA	

<Branch Line 2>

Load L_{B2}	4A	
Line Type	AAC50mm2	No.11
Line Length Len_{B1}	2.7km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	150kVA	



<Branch Line 1>

Load L_{B1}	4A	
Line Type	AAC50mm2	No.11
Line Length Len_{B1}	4.2km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	150kVA	

<Branch Line 3>

Load L_{B3}	4A	
Line Type	AAC50mm2	No.11
Line Length Len_{B3}	5.0km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B3}	150kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN C
Feeder Name	C 21

: Input data in colored cells

Type-3

Maximum Current I_{max}
300.0A

Power factor (cosθ)
0.82

Primary Substation →I_{max}

Voltage V_S: 11.0kV

<Trank Line 1>

Load L_{T1}	98A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	6.9km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	2675kVA	

L_{T1} (Distributed Load) (R_{T1} =1.9Ω X_{T1} =2.5Ω)

Trunk Line 1: Loading 66% (Rated Current =455A)

Voltage V_{i1}: 9.7kV (12%Drop)

<Trank Line 2>

Load L_{T2}	23A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2.0km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T2}	630kVA	

L_{T2} (Distributed Load) (R_{T2} =.5Ω X_{T2} =.7Ω)

Trunk Line 2: Loading 26% (Rated Current =455A)

Voltage V_{i2}: 9.5kV (13%Drop)

<Branch Line 2>

Load L_{B2}	43A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	2.7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	1165kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =.7Ω X_{B2} =1.0Ω)

Branch Line 2: Loading 9% (Rated Current =455A)

Voltage V_{r2}: 9.5kV (14%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =.7Ω X_{B1} =.9Ω)

Branch Line 1: Loading 18% (Rated Current =455A)

Voltage V_{r1}: 9.6kV (13%Drop)

<Branch Line 1>

Load L_{B1}	81A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	2.5km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	2200kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =.5Ω X_{B3} =.6Ω)

Branch Line 3: Loading 12% (Rated Current =455A)

Voltage V_{r3}: 9.5kV (14%Drop)

<Branch Line 3>

Load L_{B3}	54A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	1.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	1480kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN C
Feeder Name	C 41

: Input data in colored cells

Type-3

Maximum Current I_{max}	
300.0A	

Power factor (cosθ)	
0.82	

<Trank Line 1>

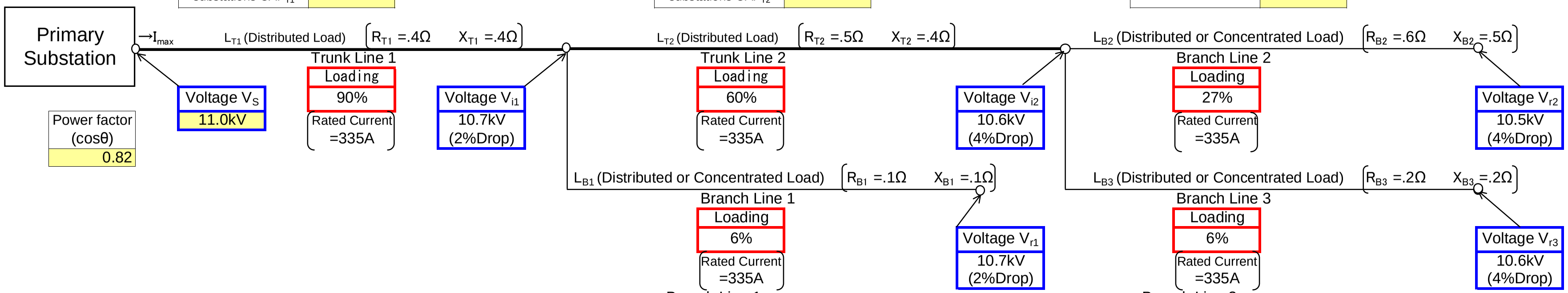
Load L_{T1}	78A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	3.0km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2000kVA	

<Trank Line 2>

Load L_{T2}	90A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	3.2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2315kVA	

<Branch Line 2>

Load L_{B2}	90A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	4.1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	2315kVA	



<Branch Line 1>

Load L_{B1}	20A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	.4km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B1}	500kVA	

<Branch Line 3>

Load L_{B3}	21A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B3}	1.2km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B3}	550kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN C
Feeder Name	C 51

: Input data in colored cells

Type-2

Maximum Current I_{max}: 330.0A

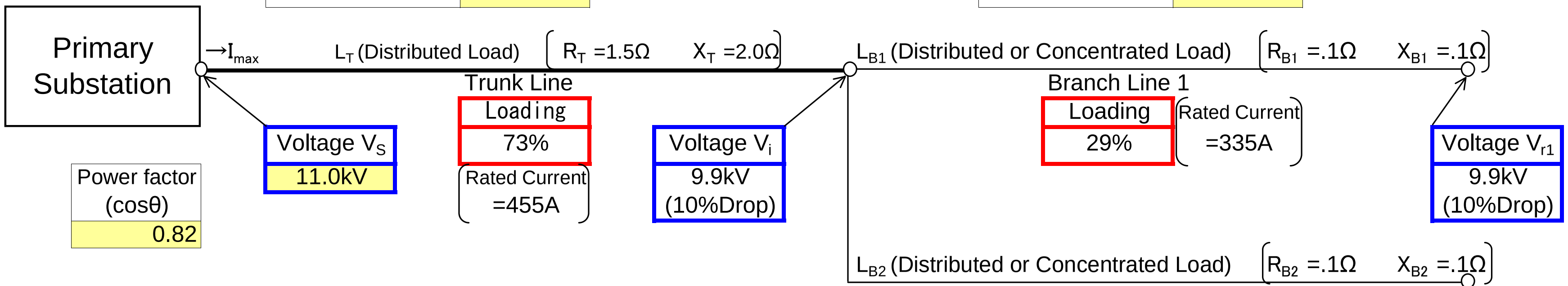
Power factor (cosθ): 0.82

<Trank Line>

Load L_T	198A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	5.5km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_T	2730kVA	

<Branch Line 1>

Load L_{B1}	95A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	1.0km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	1315kVA	



<Branch Line 2>

Load L_{B2}	36A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	.3km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B2}	500kVA	

=====Equation=====

$V_i = V_s - 1.732 \cdot (R_T \cos\theta + X_T \sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T + CAP_{B1} + CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage — I_{max} : Maximum Current — R_T, R_{B1}, R_{B2} : Resistance
V_i : Interim Voltage — L_T : Load (Trunk line) — X_T, X_{B1}, X_{B2} : Reactance
V_{r1} : Received Voltage — L_{B1} : Load (Branch Line 1) — cosθ : Power Factor
V_{r2} : Received Voltage — L_{B2} : Load (Branch Line 2) — f_T, f_{B1}, f_{B2} : Dispersal Load Factor — CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN C
Feeder Name	C 61

: Input data in colored cells

Type-3

Maximum Current I_{max}
300.0A

<Trank Line 1>

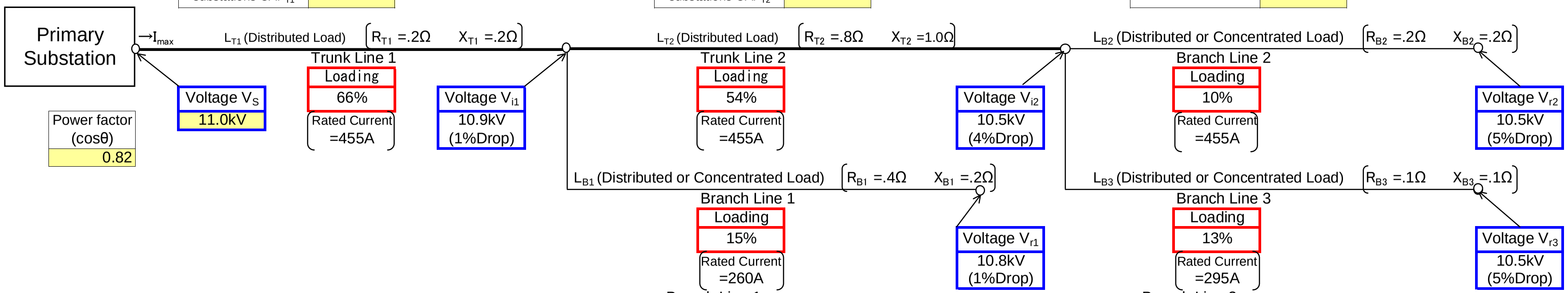
Load L_{T1}	15A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	.6km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T1}	315kVA	

<Trank Line 2>

Load L_{T2}	166A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2.9km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{T2}	3580kVA	

<Branch Line 2>

Load L_{B2}	44A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	.6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	945kVA	



<Branch Line 1>

Load L_{B1}	38A	
Line Type	AAC50mm2	No.11
Line Length Len_{B1}	.6km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	815kVA	

<Branch Line 3>

Load L_{B3}	38A	
Line Type	120CuPILC(11kV)	No.22
Line Length Len_{B3}	.6km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B3}	815kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN C
Feeder Name	C31

: Input data in colored cells

Type-3

Maximum Current I_{max}
280.0A

Power factor (cosθ)
0.82

<Trank Line 1>

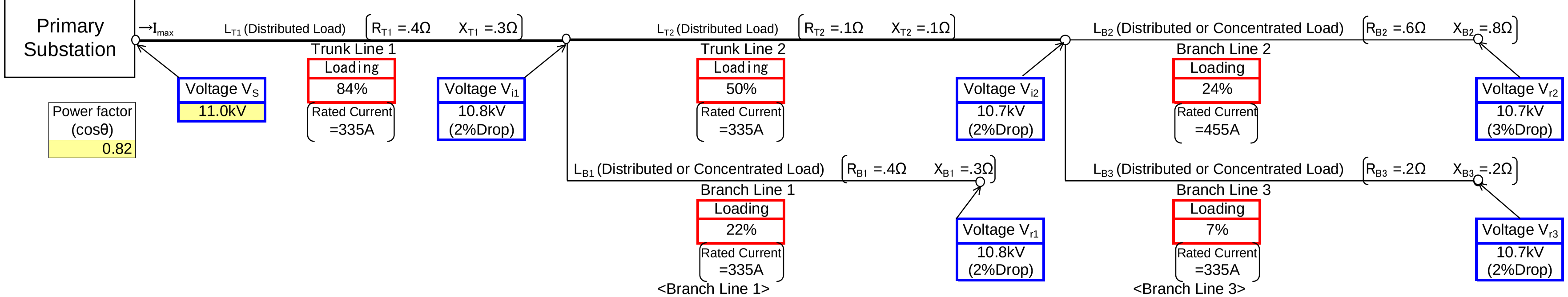
Load L_{T1}	37A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	2.4km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T1}	800kVA	

<Trank Line 2>

Load L_{T2}	34A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	.8km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T2}	750kVA	

<Branch Line 2>

Load L_{B2}	111A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	2.2km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	2430kVA	



<Branch Line 1>

Load L_{B1}	75A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	2.5km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	1630kVA	

<Branch Line 3>

Load L_{B3}	24A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B3}	1.2km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B3}	515kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN D
Feeder Name	D11

: Input data in colored cells

Type-2

<Trank Line>

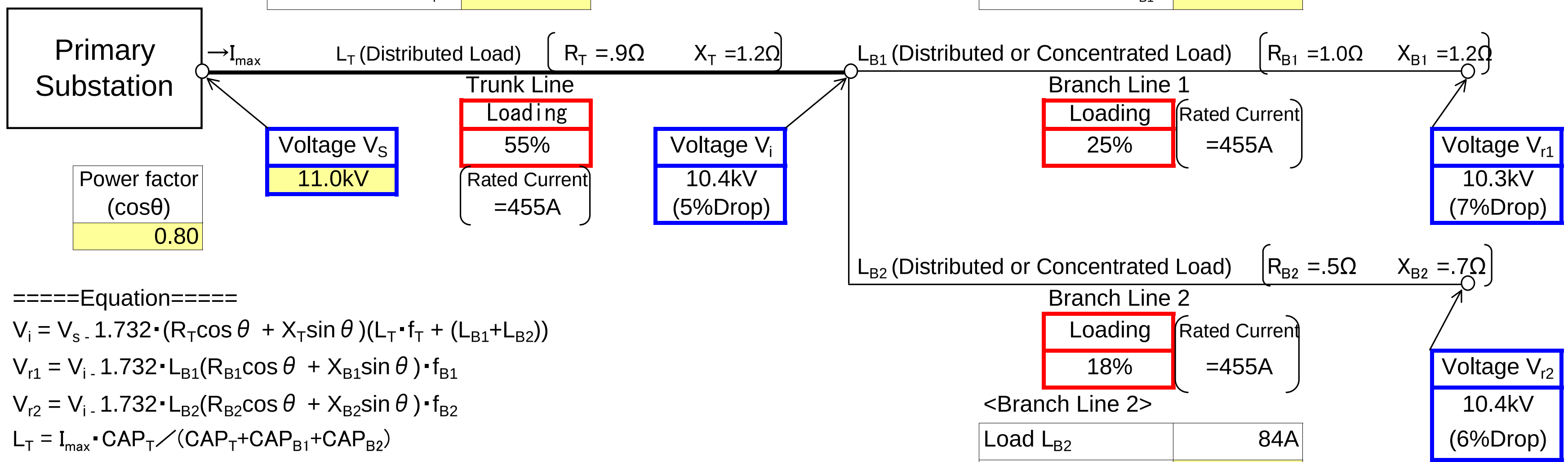
Load L_T	54A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	3.4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	2315kVA	

<Branch Line 1>

Load L_{B1}	112A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	3.5km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	4760kVA	

Maximum Current I_{max}
250.0A

Power factor (cosθ)
0.80



<Branch Line 2>

Load L_{B2}	84A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	2.0km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	3550kVA	

=====Equation=====

$V_i = V_S - 1.732 \cdot (R_T\cos\theta + X_T\sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage I_{max} : Maximum Current R_T, R_{B1}, R_{B2} : Resistance
V_i : Interim Voltage L_T : Load (Trunk line) X_T, X_{B1}, X_{B2} : Reactance
V_{r1} : Received Voltage L_{B1} : Load (Branch Line 1) cosθ : Power Factor
V_{r2} : Received Voltage L_{B2} : Load (Branch Line 2) f_T, f_{B1}, f_{B2} : Dispersal Load Factor CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN D
Feeder Name	D 21

: Input data in colored cells

Type-2

Maximum Current I_{max}: 360.0A

Power factor (cosθ): 0.80

<Trank Line>

Load L_T	145A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	4.3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	3350kVA	

<Branch Line 1>

Load L_{B1}	151A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	6.8km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	3475kVA	

Primary Substation →I_{max}

L_T (Distributed Load) (R_T =1.2Ω X_T =1.5Ω)

Trunk Line: Loading 79% (Rated Current =455A)

Voltage V_S: 11.0kV

Voltage V_i: 10.1kV (8%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =1.9Ω X_{B1} =2.4Ω)

Branch Line 1: Loading 33% (Rated Current =455A)

Voltage V_{r1}: 9.6kV (13%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =4.1Ω X_{B2} =5.3Ω)

Branch Line 2: Loading 14% (Rated Current =455A)

Voltage V_{r2}: 9.8kV (11%Drop)

<Branch Line 2>

Load L_{B2}	64A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	14.8km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	1480kVA	

=====Equation=====

$V_i = V_S - 1.732 \cdot (R_T \cos\theta + X_T \sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_T, R_{B1}, R_{B2}	: Resistance
V_i	: Interim Voltage	L_T	: Load (Trunk line)	X_T, X_{B1}, X_{B2}	: Reactance
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	cosθ	: Power Factor
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	f_T, f_{B1}, f_{B2}	: Dispersal Load Factor

CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN D
Feeder Name	D 31

: Input data in colored cells

Type-3

Maximum Current I_{max}
410.0A

Power factor (cosθ)
0.80

<Trank Line 1>

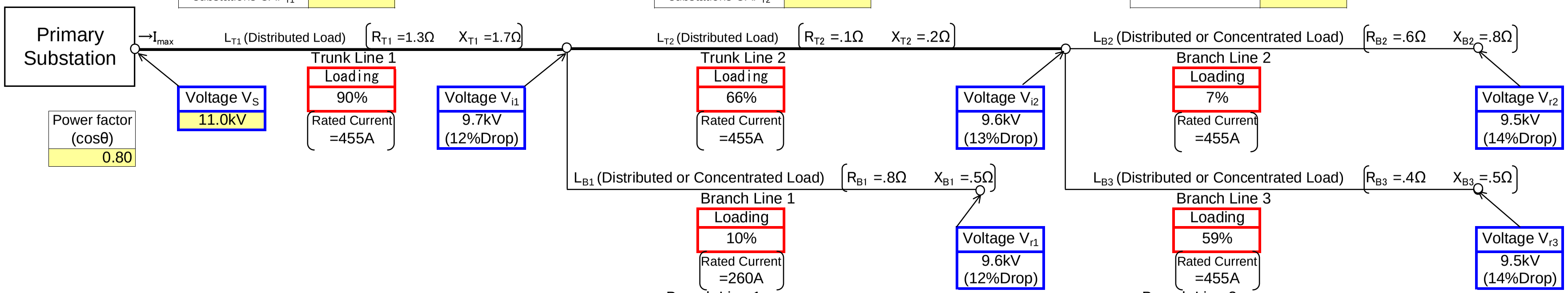
Load L_{T1}	83A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2200kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	.5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	31A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	2.3km	
Type of Distributed Load		
Total Transformer Capacity of secondary substations CAP_{B2}	815kVA	



<Branch Line 1>

Load L_{B1}	27A	
Line Type	AAC50mm2	No.11
Line Length Len_{B1}	1.3km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	715kVA	

<Branch Line 3>

Load L_{B3}	270A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	1.4km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B3}	7165kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN D
Feeder Name	D 51

: Input data in colored cells

Type-3

Maximum Current I_{max}
180.0A

Power factor (cosθ)
0.80

<Trank Line 1>

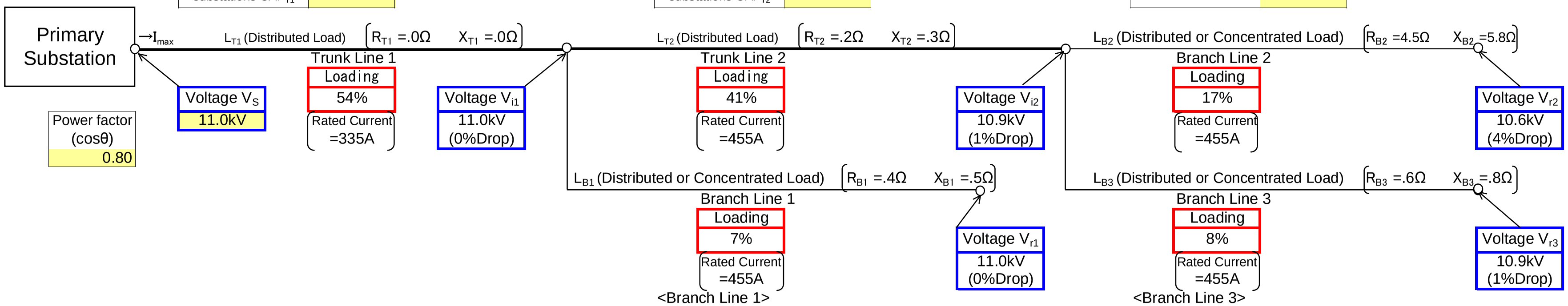
Load L_{T1}	12A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	.3km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T1}	750kVA	

<Trank Line 2>

Load L_{T2}	20A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	.9km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{T2}	1300kVA	

<Branch Line 2>

Load L_{B2}	79A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	16.3km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	5055kVA	



<Branch Line 1>

Load L_{B1}	31A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	1.4km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	2000kVA	

<Branch Line 3>

Load L_{B3}	38A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	2.2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	2415kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN D
Feeder Name	D 41

: Input data in colored cells

Type-2

Maximum Current I_{max}
185.0A

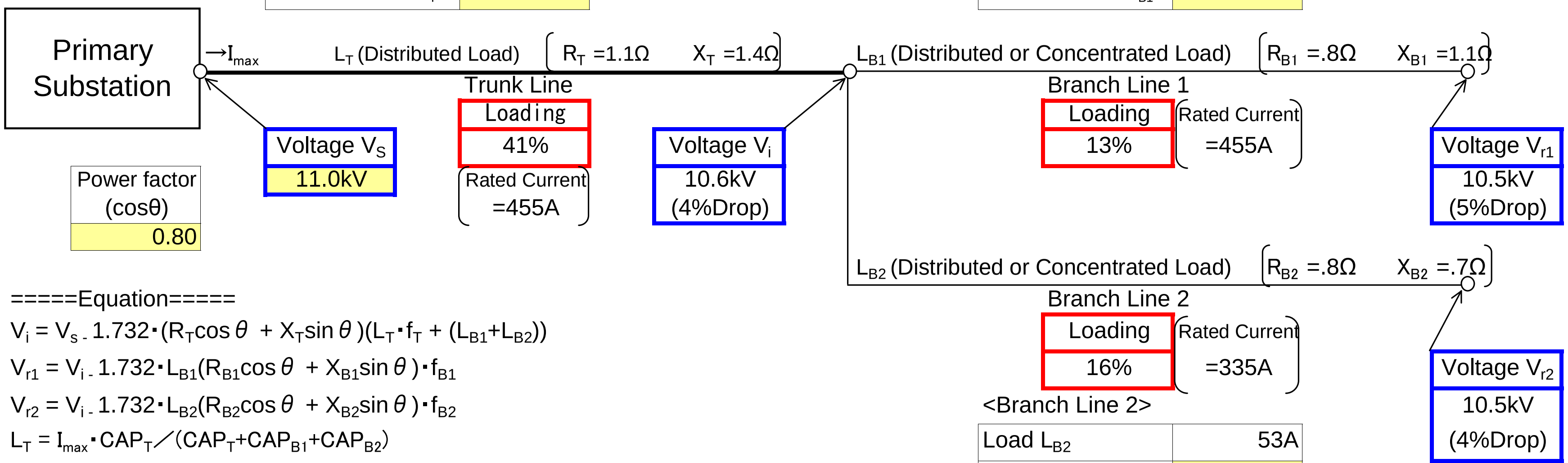
Power factor ($\cos\theta$)
0.80

<Trank Line>

Load L_T	71A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	4.0km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	4750kVA	

<Branch Line 1>

Load L_{B1}	60A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	3.0km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	4000kVA	



<Branch Line 2>

Load L_{B2}	53A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	5.2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	3545kVA	

=====Equation=====

$V_i = V_S - 1.732 \cdot (R_T\cos\theta + X_T\sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage　I_{max} : Maximum Current　R_T, R_{B1}, R_{B2} : Resistance
V_i : Interim Voltage　L_T : Load (Trunk line)　X_T, X_{B1}, X_{B2} : Reactance
V_{r1} : Received Voltage　L_{B1} : Load (Branch Line 1)　$\cos\theta$: Power Factor
V_{r2} : Received Voltage　L_{B2} : Load (Branch Line 2)　f_T, f_{B1}, f_{B2} : Dispersal Load Factor　$CAP_T, CAP_{B1}, CAP_{B2}$: Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN D
Feeder Name	D 41

: Input data in colored cells

Type-3

Maximum Current I_{max}	
185.0A	

Power factor (cosθ)
0.80

<Trank Line 1>

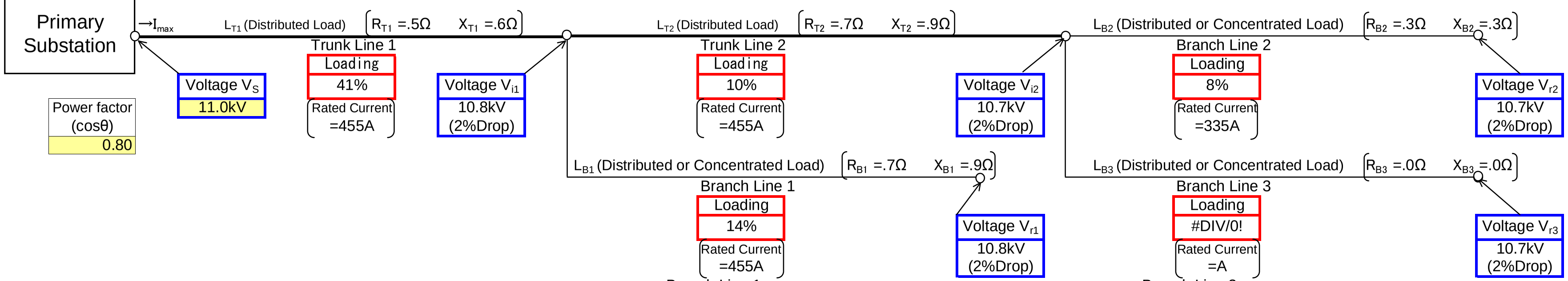
Load L_{T1}	75A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	1.7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	4750kVA	

<Trank Line 2>

Load L_{T2}	21A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2.4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1345kVA	

<Branch Line 2>

Load L_{B2}	27A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	2.1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	1700kVA	



<Branch Line 1>

Load L_{B1}	63A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	2.4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	4000kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Line Length Len_{B3}		
Type of Distributed Load		
Total Transformer Capacity of secondary substations CAP_{B3}		

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	STATION E
Feeder Name	E 11

: Input data in colored cells

Type-3

Primary Substation

Maximum Current I_{max}	360.0A
Power factor (cosθ)	0.97

Voltage V_s
11.0kV

<Trank Line 1>

Load L_{T1}	A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	.6km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T1}	kVA	

$\rightarrow I_{max}$ L_{T1} (Distributed Load) (R_{T1} =.2Ω X_{T1} =.2Ω)

Trunk Line 1: Loading 79% (Rated Current =455A)

Voltage V_{i1}: 10.9kV (1%Drop)

<Trank Line 2>

Load L_{T2}	250A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	9.5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	8560kVA	

L_{T2} (Distributed Load) (R_{T2} =2.6Ω X_{T2} =3.4Ω)

Trunk Line 2: Loading 59% (Rated Current =455A)

Voltage V_{i2}: 10.0kV (9%Drop)

<Branch Line 2>

Load L_{B2}	14A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	7.5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	475kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =2.1Ω X_{B2} =2.7Ω)

Branch Line 2: Loading 3% (Rated Current =455A)

Voltage V_{r2}: 10.0kV (9%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =.7Ω X_{B1} =1.0Ω)

Branch Line 1: Loading 20% (Rated Current =455A)

Voltage V_{r1}: 10.8kV (2%Drop)

<Branch Line 1>

Load L_{B1}	91A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	2.7km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	3115kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =1.6Ω X_{B3} =1.0Ω)

Branch Line 3: Loading 2% (Rated Current =260A)

Voltage V_{r3}: 10.0kV (9%Drop)

<Branch Line 3>

Load L_{B3}	6A	
Line Type	AAC50mm2	No.11
Line Length Len_{B3}	2.7km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B3}	200kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	STATION E
Feeder Name	E 21

: Input data in colored cells

Type-3

Maximum Current I_{max}
280.0A

Power factor (cosθ)
0.97

Primary Substation

Voltage V_S: 11.0kV

<Trank Line 1>

Load L_{T1}	83A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2.8km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	3995kVA	

→I_{max} L_{T1} (Distributed Load) (R_{T1} =.8Ω X_{T1} =1.0Ω)

Trunk Line 1: Loading 62% (Rated Current =455A)

Voltage V_{i1}: 10.6kV (4%Drop)

<Trank Line 2>

Load L_{T2}	48A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	2.5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2315kVA	

L_{T2} (Distributed Load) (R_{T2} =.4Ω X_{T2} =.3Ω)

Trunk Line 2: Loading 43% (Rated Current =335A)

Voltage V_{i2}: 10.4kV (5%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =.0Ω X_{B1} =.0Ω)

Branch Line 1: Loading #DIV/0! (Rated Current =A)

Voltage V_{r1}: 10.6kV (4%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Line Length Len_{B1}	.0km	
Type of Distributed Load		
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 2>

Load L_{B2}	149A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	7.2km	
Type of Distributed Load	Middle Smaller	
Total Transformer Capacity of secondary substations CAP_{B2}	7140kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =2.0Ω X_{B2} =2.6Ω)

Branch Line 2: Loading 33% (Rated Current =455A)

Voltage V_{r2}: 10.1kV (8%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =.0Ω X_{B3} =.0Ω)

Branch Line 3: Loading #DIV/0! (Rated Current =A)

Voltage V_{r3}: 10.4kV (5%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Line Length Len_{B3}	.0km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	EFFIDUASE S/S
Feeder Name	EFFIDUASE

: Input data in colored cells

Type-2

Maximum Current I_{max}: 72.0A

Power factor ($\cos\theta$): 0.90

<Trank Line>

Load L_T	27A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	3.1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	1395kVA	

<Branch Line 1>

Load L_{B1}	15A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	10.5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	750kVA	

Primary Substation → I_{max}

L_T (Distributed Load) (R_T =.9Ω X_T =1.1Ω)

Trunk Line: Loading 16% (Rated Current =455A)

Voltage V_S: 11.0kV

Voltage V_i: 10.9kV (1%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =2.9Ω X_{B1} =3.7Ω)

Branch Line 1: Loading 3% (Rated Current =455A)

Voltage V_{r1}: 10.8kV (2%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =1.4Ω X_{B2} =1.8Ω)

Branch Line 2: Loading 7% (Rated Current =455A)

Voltage V_{r2}: 10.8kV (2%Drop)

<Branch Line 2>

Load L_{B2}	30A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	5.0km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	1510kVA	

=====Equation=====

$V_i = V_S - 1.732 \cdot (R_T\cos\theta + X_T\sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_T, R_{B1}, R_{B2}	: Resistance
V_i	: Interim Voltage	L_T	: Load (Trunk line)	X_T, X_{B1}, X_{B2}	: Reactance
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	cosθ	: Power Factor
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	f_T, f_{B1}, f_{B2}	: Dispersal Load Factor

CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	EFFIDUASE S/S
Feeder Name	EJISU

: Input data in colored cells

Type-2

Maximum Current I_{max}
72.0A

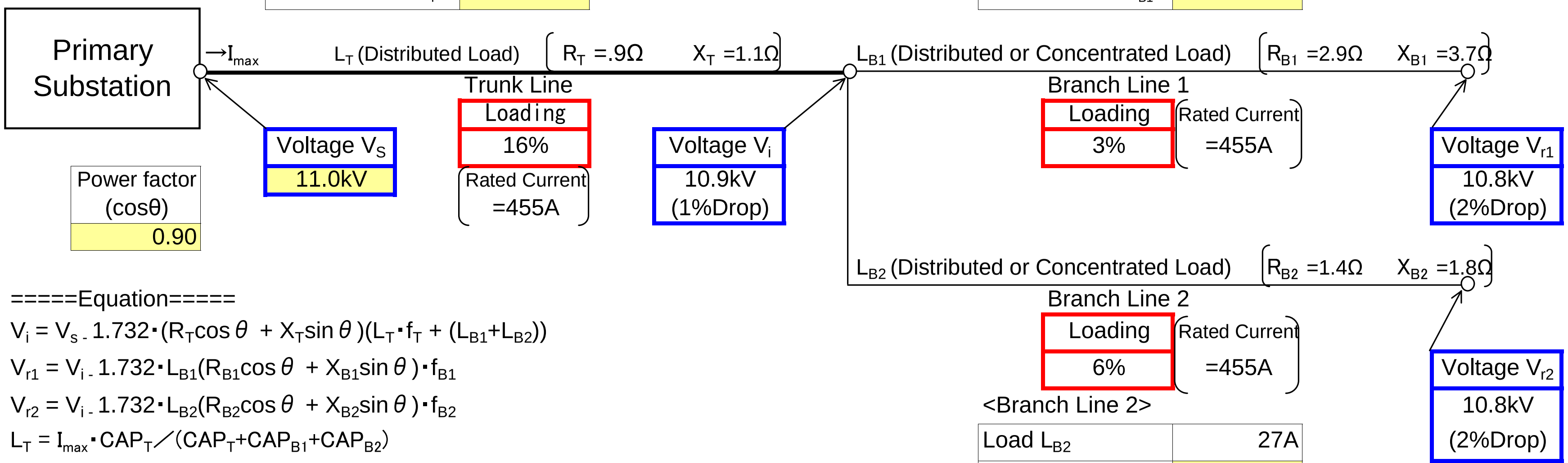
Power factor (cosθ)
0.90

<Trank Line>

Load L_T	32A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	3.1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	1810kVA	

<Branch Line 1>

Load L_{B1}	13A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	10.5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	750kVA	



<Branch Line 2>

Load L_{B2}	27A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	5.0km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	1510kVA	

=====Equation=====

$V_i = V_S - 1.732 \cdot (R_T\cos\theta + X_T\sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage　I_{max} : Maximum Current　R_T, R_{B1}, R_{B2} : Resistance
V_i : Interim Voltage　L_T : Load (Trunk line)　X_T, X_{B1}, X_{B2} : Reactance
V_{r1} : Received Voltage　L_{B1} : Load (Branch Line 1)　cosθ : Power Factor
V_{r2} : Received Voltage　L_{B2} : Load (Branch Line 2)　f_T, f_{B1}, f_{B2} : Dispersal Load Factor　CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	EFFIDUASE
Feeder Name	EJISU

: Input data in colored cells

Type-3

Maximum Current I_{max}
109.0A

Power factor (cosθ)
0.90

<Trank Line 1>

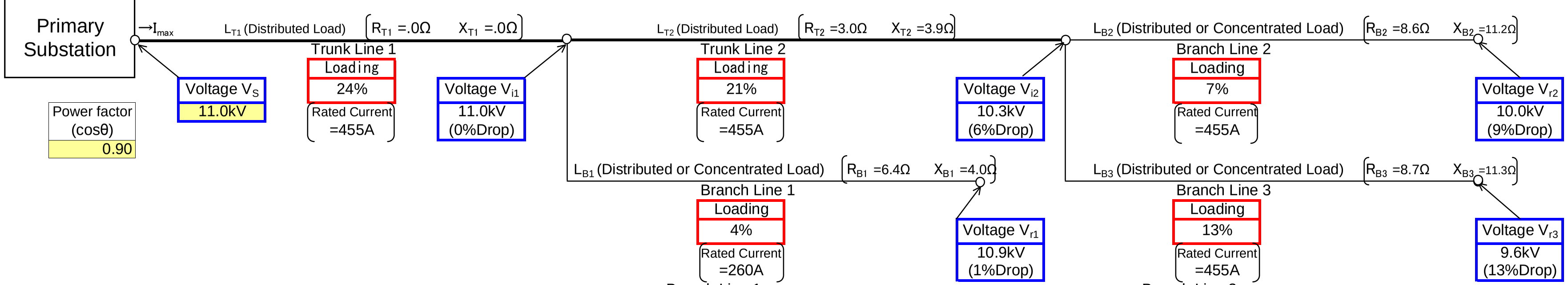
Load L_{T1}	A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	.1km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T1}	kVA	

<Trank Line 2>

Load L_{T2}	8A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	10.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	575kVA	

<Branch Line 2>

Load L_{B2}	30A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	31.3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	2230kVA	



<Branch Line 1>

Load L_{B1}	11A	
Line Type	AAC50mm2	No.11
Line Length Len_{B1}	10.5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	850kVA	

<Branch Line 3>

Load L_{B3}	60A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	31.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	4500kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	MAIN F
Feeder Name	F 11

: Input data in colored cells

Type-3

Maximum Current I_{max}
194.0A

Power factor (cosθ)
0.80

<Trank Line 1>

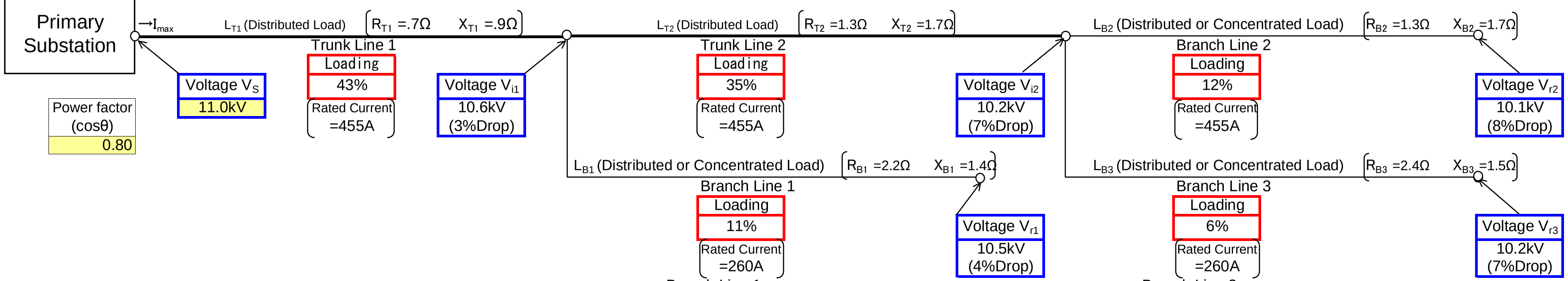
Load L_{T1}	7A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2.6km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	400kVA	

<Trank Line 2>

Load L_{T2}	89A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	4.7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	5310kVA	

<Branch Line 2>

Load L_{B2}	53A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	4.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	3175kVA	



<Branch Line 1>

Load L_{B1}	29A	
Line Type	AAC50mm2	No.11
Line Length Len_{B1}	3.6km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	1740kVA	

<Branch Line 3>

Load L_{B3}	17A	
Line Type	AAC50mm2	No.11
Line Length Len_{B3}	3.9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	1000kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$,
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN F
Feeder Name	F 31

: Input data in colored cells

Type-2

Maximum Current I_{max}
159.0A

Power factor (cosθ)
0.80

<Trank Line>

Load L_T	106A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	11.5km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_T	1905kVA	

<Branch Line 1>

Load L_{B1}	31A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	2.8km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	565kVA	

<Branch Line 2>

Load L_{B2}	22A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	4.1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	400kVA	

Primary Substation →I_{max}

L_T (Distributed Load) (R_T =3.2Ω X_T =4.1Ω)

Trunk Line

Loading
35%

(Rated Current =455A)

Voltage V_S
11.0kV

Voltage V_i
10.1kV (8%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =.8Ω X_{B1} =1.0Ω)

Branch Line 1

Loading
7%

(Rated Current =455A)

Voltage V_{r1}
10.0kV (9%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =1.1Ω X_{B2} =1.5Ω)

Branch Line 2

Loading
5%

(Rated Current =455A)

Voltage V_{r2}
10.0kV (9%Drop)

=====Equation=====

$V_i = V_S - 1.732 \cdot (R_T \cos\theta + X_T \sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage, I_{max} : Maximum Current, R_T, R_{B1}, R_{B2} : Resistance

V_i : Interim Voltage, L_T : Load (Trunk line), X_T, X_{B1}, X_{B2} : Reactance

V_{r1} : Received Voltage, L_{B1} : Load (Branch Line 1), cosθ : Power Factor

V_{r2} : Received Voltage, L_{B2} : Load (Branch Line 2), f_T, f_{B1}, f_{B2} : Dispersal Load Factor, $CAP_T, CAP_{B1}, CAP_{B2}$: Total Transformer Capacity of secondary substations

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	MAIN F
Feeder Name	F 41

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	3A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	1.7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	100kVA	

<Trank Line 2>

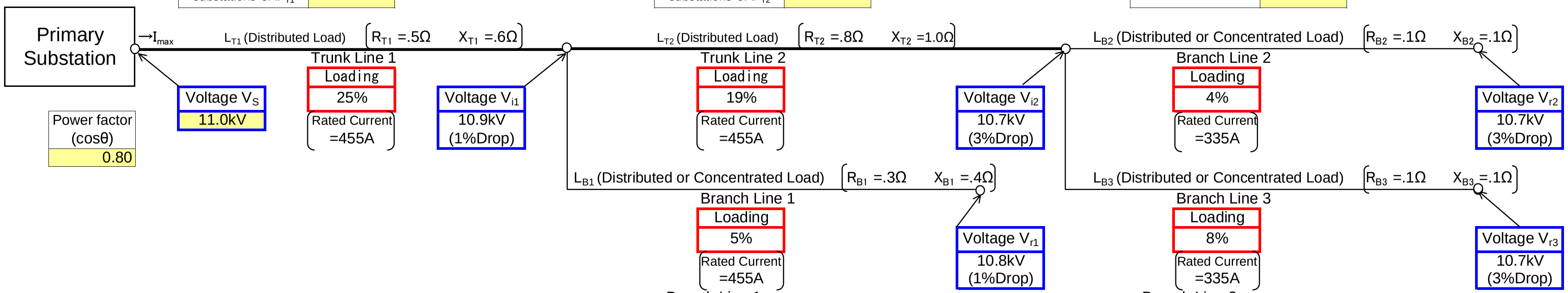
Load L_{T2}	47A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1695kVA	

<Branch Line 2>

Load L_{B2}	14A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	.5km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B2}	500kVA	

Maximum Current I_{max}
113.0A

Power factor (cosθ)
0.80



<Branch Line 1>

Load L_{B1}	22A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	1.2km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	800kVA	

<Branch Line 3>

Load L_{B3}	28A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B3}	1.0km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	1000kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

- V_s : Supply Voltage
- V_{i1} : Interim Voltage
- V_{i2} : Interim Voltage
- V_{r1} : Received Voltage
- V_{r2} : Received Voltage
- V_{r3} : Received Voltage
- I_{max} : Maximum Current
- L_{T1} : Load (Trunk line 1)
- L_{T2} : Load (Trunk line 2)
- L_{B1} : Load (Branch Line 1)
- L_{B2} : Load (Branch Line 2)
- L_{B3} : Load (Branch Line 3)
- R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3} : Resistance
- X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3} : Reactance
- f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3} : Dispersal Load Factor
- CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
- cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	OBUASI
Feeder Name	FOMENA

: Input data in colored cells

Type-3

Maximum Current I_{max}	
270.0A	

Power factor (cosθ)	
0.85	

<Trank Line 1>

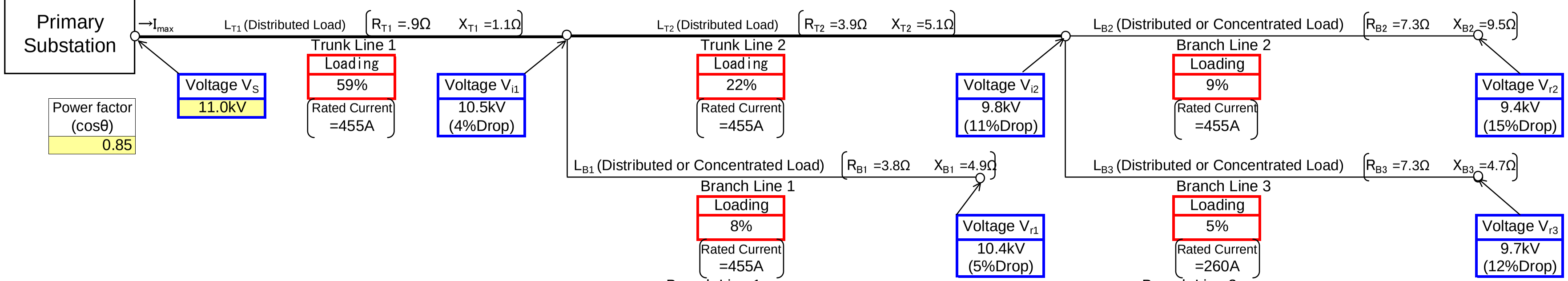
Load L_{T1}	133A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3.2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	6350kVA	

<Trank Line 2>

Load L_{T2}	46A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	14.2km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{T2}	2200kVA	

<Branch Line 2>

Load L_{B2}	42A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	26.6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	2025kVA	



<Branch Line 1>

Load L_{B1}	35A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	13.7km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	1690kVA	

<Branch Line 3>

Load L_{B3}	13A	
Line Type	AAC50mm2	No.11
Line Length Len_{B3}	12.1km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B3}	600kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	MAIN A
Feeder Name	GBC

: Input data in colored cells

Type-3

Maximum Current I_{max}
200.0A

<Trank Line 1>

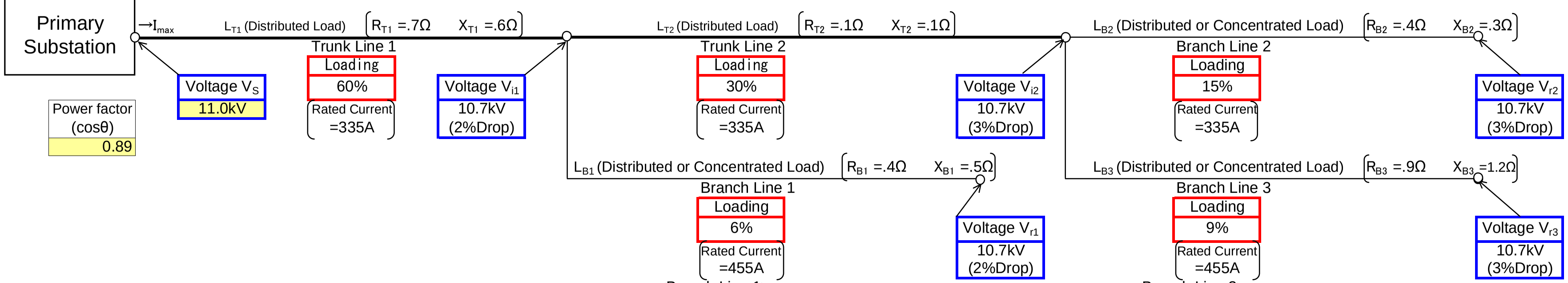
Load L_{T1}	74A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	4.9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2950kVA	

<Trank Line 2>

Load L_{T2}	13A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	.8km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T2}	500kVA	

<Branch Line 2>

Load L_{B2}	49A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	2.6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	1930kVA	



<Branch Line 1>

Load L_{B1}	25A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	1.3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	1000kVA	

<Branch Line 3>

Load L_{B3}	39A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	3.4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	1545kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN A
Feeder Name	GUINNESS 1

: Input data in colored cells

Type-3

Primary Substation

Maximum Current I_{max}
190.0A

Power factor (cosθ)
0.89

Voltage V_S: 11.0kV

<Trank Line 1>

Load L_{T1}	24A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2.5km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	945kVA	

→I_{max} L_{T1} (Distributed Load) R_{T1} =.7Ω X_{T1} =.9Ω

Trunk Line 1: Loading 42% (Rated Current =455A)

Voltage V_{i1}: 10.7kV (3%Drop)

<Trank Line 2>

Load L_{T2}	38A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	1.3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1500kVA	

L_{T2} (Distributed Load) R_{T2} =.2Ω X_{T2} =.2Ω

Trunk Line 2: Loading 33% (Rated Current =335A)

Voltage V_{i2}: 10.6kV (3%Drop)

<Branch Line 2>

Load L_{B2}	97A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	4.2km	
Type of Distributed Load		
Total Transformer Capacity of secondary substations CAP_{B2}	3815kVA	

L_{B2} (Distributed or Concentrated Load) R_{B2} =1.2Ω X_{B2} =1.5Ω

Branch Line 2: Loading 21% (Rated Current =455A)

Voltage V_{r2}: 10.3kV (6%Drop)

L_{B1} (Distributed or Concentrated Load) R_{B1} =.1Ω X_{B1} =.2Ω

Branch Line 1: Loading 3% (Rated Current =455A)

Voltage V_{r1}: 10.7kV (3%Drop)

<Branch Line 1>

Load L_{B1}	15A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	.5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	600kVA	

L_{B3} (Distributed or Concentrated Load) R_{B3} =.3Ω X_{B3} =.4Ω

Branch Line 3: Loading 4% (Rated Current =455A)

Voltage V_{r3}: 10.6kV (3%Drop)

<Branch Line 3>

Load L_{B3}	16A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	1.2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	630kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

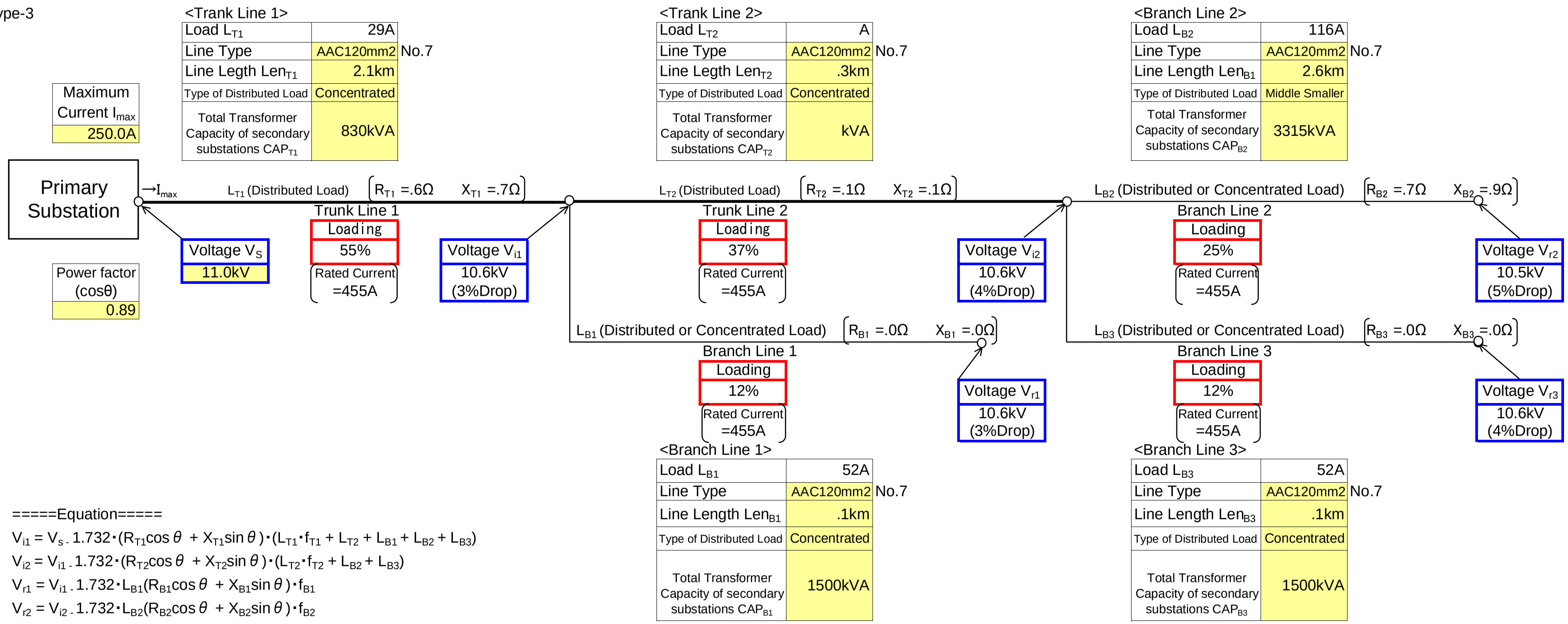
V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN A
Feeder Name	GUINESS 2

: Input data in colored cells

Type-3



=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN A
Feeder Name	INDUSTRIAL OHL

: Input data in colored cells

Type-3

Maximum Current I_{max}: 320.0A

Power factor (cosθ): 0.89

Primary Substation → I_{max}

Voltage V_S: 11.0kV

<Trank Line 1>

Load L_{T1}	13A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	1.0km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	600kVA	

L_{T1} (Distributed Load) (R_{T1} =.3Ω X_{T1} =.4Ω)

Trunk Line 1 — Loading 70% (Rated Current =455A)

Voltage V_{i1}: 10.8kV (2%Drop)

<Trank Line 2>

Load L_{T2}	16A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	.3km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T2}	750kVA	

L_{T2} (Distributed Load) (R_{T2} =.1Ω X_{T2} =.1Ω)

Trunk Line 2 — Loading 61% (Rated Current =455A)

Voltage V_{i2}: 10.7kV (3%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =.5Ω X_{B1} =.6Ω)

Branch Line 1 — Loading 6% (Rated Current =455A)

Voltage V_{r1}: 10.8kV (2%Drop)

<Branch Line 1>

Load L_{B1}	28A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	1.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	1300kVA	

<Branch Line 2>

Load L_{B2}	84A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	1.6km	
Type of Distributed Load	Middle Smaller	
Total Transformer Capacity of secondary substations CAP_{B2}	3900kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =.2Ω X_{B2} =.2Ω)

Branch Line 2 — Loading 25% (Rated Current =335A)

Voltage V_{r2}: 10.7kV (3%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =2.6Ω X_{B3} =.6Ω)

Branch Line 3 — Loading 115% (Rated Current =155A)

Voltage V_{r3}: 10.3kV (6%Drop)

<Branch Line 3>

Load L_{B3}	179A	
Line Type	35CuPILC(11kV)	No.17
Line Length Len_{B3}	3.9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	8280kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	BEKWAI
Feeder Name	KOKOFU

: Input data in colored cells

Type-3

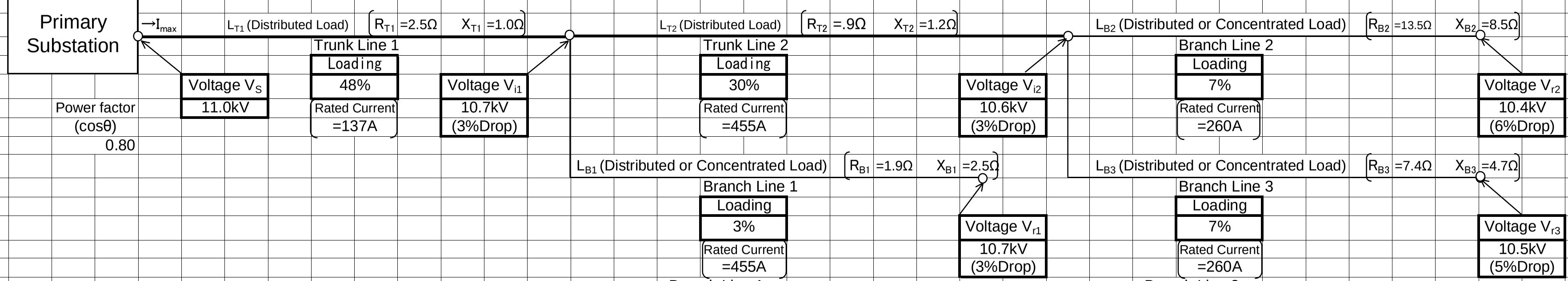
Maximum Current I_{max}: 66.0A

Power factor (cosθ): 0.80

<Trank Line 1>		
Load L_{T1}	10A	
Line Type	Cu16mm2	No.16
Line Legth Len_{T1}	1.9km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	300kVA	

<Trank Line 2>		
Load L_{T2}	5A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	3.4km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{T2}	150kVA	

<Branch Line 2>		
Load L_{B2}	18A	
Line Type	AAC50mm2	No.11
Line Length Len_{B1}	22.2km	
Type of Distributed Load	Middle Smaller	
Total Transformer Capacity of secondary substations CAP_{B2}	550kVA	



<Branch Line 1>		
Load L_{B1}	15A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	7.1km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	450kVA	

<Branch Line 3>		
Load L_{B3}	18A	
Line Type	AAC50mm2	No.11
Line Length Len_{B3}	12.2km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B3}	550kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	KONONGO
Feeder Name	KONONGO

: Input data in colored cells

Type-3

Maximum Current I_{max}	165.0A
Power factor (cosθ)	0.85

<Trank Line 1>

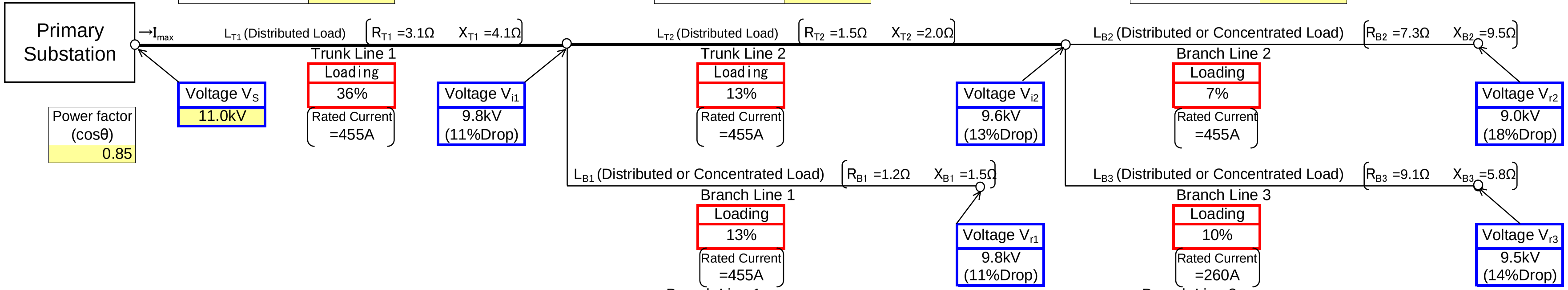
Load L_{T1}	51A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	11.4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1700kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	5.6km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	32A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	26.5km	
Type of Distributed Load		
Total Transformer Capacity of secondary substations CAP_{B2}	1050kVA	



<Branch Line 1>

Load L_{B1}	57A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	4.3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	1890kVA	

<Branch Line 3>

Load L_{B3}	25A	
Line Type	AAC50mm2	No.11
Line Length Len_{B3}	15.0km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B3}	840kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	KUMAWU
Feeder Name	KUMAWU 11KV

: Input data in colored cells

Type-2

<Trank Line>

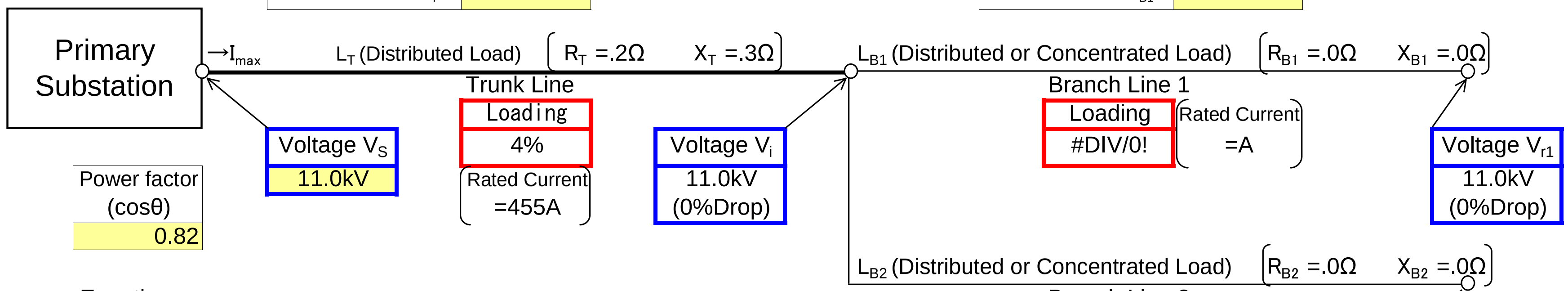
Load L_T	16A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	.8km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_T	315kVA	

<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Line Length Len_{B1}		
Type of Distributed Load		
Total Transformer Capacity of secondary substations CAP_{B1}		

Maximum Current I_{max}
16.0A

Power factor (cosθ)
0.82



<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Line Length Len_{B1}		
Type of Distributed Load		
Total Transformer Capacity of secondary substations CAP_{B2}		

=====Equation=====

$V_i = V_S - 1.732 \cdot (R_T \cos\theta + X_T \sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_T, R_{B1}, R_{B2} : Resistance	
V_i : Interim Voltage	L_T : Load (Trunk line)	X_T, X_{B1}, X_{B2} : Reactance	
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	cosθ : Power Factor	
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	f_T, f_{B1}, f_{B2} : Dispersal Load Factor	CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	KUMAWU
Feeder Name	KUMAWU 11KV

: Input data in colored cells

Type-3

Maximum Current I_{max}	Power factor (cosθ)
16.0A	0.82

<Trank Line 1>

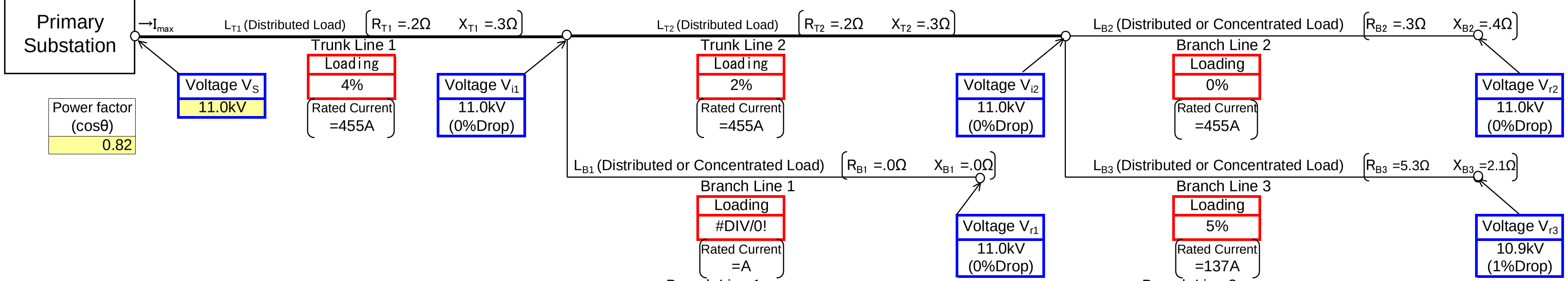
Load L_{T1}	7A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	.8km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T1}	315kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	2A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	1.1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	100kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Line Length Len_{B1}		
Type of Distributed Load		
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	7A	
Line Type	Cu16mm2	No.16
Line Length Len_{B3}	4.1km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B3}	315kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage
V_{i1} : Interim Voltage
V_{i2} : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
V_{r3} : Received Voltage

I_{max} : Maximum Current
L_{T1} : Load (Trunk line 1)
L_{T2} : Load (Trunk line 2)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
L_{B3} : Load (Branch Line 3)

$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
$CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3}$: Total Transformer Capacity of secondary substations
cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN A
Feeder Name	L L L

: Input data in colored cells

Type-2

Maximum Current I_{max}
110.0A

Power factor ($\cos\theta$)
0.89

<Trank Line>

Load L_T	52A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_T	1.3km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_T	3000kVA	

<Branch Line 1>

Load L_{B1}	58A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	2.5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	3400kVA	

Primary Substation

$\rightarrow I_{max}$

L_T (Distributed Load) (R_T =.2Ω X_T =.2Ω)

Trunk Line

Loading
33%

(Rated Current =335A)

Voltage V_S
11.0kV

Voltage V_i
11.0kV (0%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =.4Ω X_{B1} =.3Ω)

Branch Line 1

Loading
17%

(Rated Current =335A)

Voltage V_{r1}
10.9kV (1%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =.0Ω X_{B2} =.0Ω)

Branch Line 2

Loading
#DIV/0!

(Rated Current =A)

Voltage V_{r2}
11.0kV (0%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Line Length Len_{B1}		
Type of Distributed Load		
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

=====Equation=====

$V_i = V_S - 1.732 \cdot (R_T\cos\theta + X_T\sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage I_{max} : Maximum Current R_T, R_{B1}, R_{B2} : Resistance
V_i : Interim Voltage L_T : Load (Trunk line) X_T, X_{B1}, X_{B2} : Reactance
V_{r1} : Received Voltage L_{B1} : Load (Branch Line 1) $\cos\theta$: Power Factor
V_{r2} : Received Voltage L_{B2} : Load (Branch Line 2) f_T, f_{B1}, f_{B2} : Dispersal Load Factor $CAP_T, CAP_{B1}, CAP_{B2}$: Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN A
Feeder Name	LAKE ROAD

: Input data in colored cells

Type-3

Maximum Current I_{max}
370.0A

Power factor (cosθ)
0.89

Primary Substation →I_{max}

Voltage V_S: 11.0kV

<Trank Line 1>

Load L_{T1}	187A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	3.1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	4345kVA	

L_{T1} (Distributed Load) (R_{T1} =.5Ω X_{T1} =.4Ω)

Trunk Line 1 — Loading: 110% (Rated Current =335A)

Voltage V_{i1}: 10.7kV (3%Drop)

<Trank Line 2>

Load L_{T2}	13A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	.8km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T2}	300kVA	

L_{T2} (Distributed Load) (R_{T2} =.1Ω X_{T2} =.1Ω)

Trunk Line 2 — Loading: 31% (Rated Current =335A)

Voltage V_{i2}: 10.7kV (3%Drop)

<Branch Line 2>

Load L_{B2}	70A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	2.2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	1630kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =.6Ω X_{B2} =.8Ω)

Branch Line 2 — Loading: 15% (Rated Current =455A)

Voltage V_{r2}: 10.6kV (3%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =.1Ω X_{B1} =.1Ω)

Branch Line 1 — Loading: 23% (Rated Current =335A)

Voltage V_{r1}: 10.7kV (3%Drop)

<Branch Line 1>

Load L_{B1}	78A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	1815kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =.1Ω X_{B3} =.1Ω)

Branch Line 3 — Loading: 6% (Rated Current =335A)

Voltage V_{r3}: 10.7kV (3%Drop)

<Branch Line 3>

Load L_{B3}	22A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B3}	.8km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B3}	500kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	EFFIDUASE S/S
Feeder Name	EFFIDUASE

: Input data in colored cells

Type-2

Maximum Current I_{max}: 72.0A

Power factor (cosθ): 0.90

<Trank Line>

Load L_T	32A
Line Type	AAC120mm2 No.7
Line Legth Len_T	3.1km
Type of Distributed Load	Equality
Total Transformer Capacity of secondary substations CAP_T	1810kVA

<Branch Line 1>

Load L_{B1}	13A
Line Type	AAC120mm2 No.7
Line Length Len_{B1}	10.5km
Type of Distributed Load	Equality
Total Transformer Capacity of secondary substations CAP_{B1}	750kVA

Primary Substation

→I_{max}

L_T (Distributed Load) (R_T =.9Ω X_T =1.1Ω)

Trunk Line

Loading
16%

(Rated Current =455A)

Voltage V_S
11.0kV

Voltage V_i
10.9kV (1%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =2.9Ω X_{B1} =3.7Ω)

Branch Line 1

Loading
3%

(Rated Current =455A)

Voltage V_{r1}
10.8kV (2%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =1.4Ω X_{B2} =1.8Ω)

Branch Line 2

Loading
6%

(Rated Current =455A)

Voltage V_{r2}
10.8kV (2%Drop)

<Branch Line 2>

Load L_{B2}	27A
Line Type	AAC120mm2 No.7
Line Length Len_{B1}	5.0km
Type of Distributed Load	Equality
Total Transformer Capacity of secondary substations CAP_{B2}	1510kVA

=====Equation=====

$V_i = V_S - 1.732 \cdot (R_T \cos\theta + X_T \sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T + CAP_{B1} + CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage — I_{max} : Maximum Current — R_T, R_{B1}, R_{B2} : Resistance
V_i : Interim Voltage — L_T : Load (Trunk line) — X_T, X_{B1}, X_{B2} : Reactance
V_{r1} : Received Voltage — L_{B1} : Load (Branch Line 1) — cosθ : Power Factor
V_{r2} : Received Voltage — L_{B2} : Load (Branch Line 2) — f_T, f_{B1}, f_{B2} : Dispersal Load Factor — CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	NSUTA
Feeder Name	MAMPONG

: Input data in colored cells

Type-3

Maximum Current I_{max}
126.0A

Power factor (cosθ)
0.97

Primary Substation →I_{max}

Voltage V_S: 11.0kV

<Trank Line 1>

Load L_{T1}	11A
Line Type	AAC120mm2 No.7
Line Legth Len_{T1}	4.8km
Type of Distributed Load	Concentrated
Total Transformer Capacity of secondary substations CAP_{T1}	415kVA

L_{T1} (Distributed Load) (R_{T1} =1.3Ω X_{T1} =1.7Ω)

Trunk Line 1 — Loading 28% (Rated Current =455A)

Voltage V_{i1}: 10.6kV (3%Drop)

<Trank Line 2>

Load L_{T2}	79A
Line Type	Cu16mm2 No.16
Line Legth Len_{T2}	10.9km
Type of Distributed Load	Middle Larger
Total Transformer Capacity of secondary substations CAP_{T2}	2955kVA

L_{T2} (Distributed Load) (R_{T2} =14.1Ω X_{T2} =5.5Ω)

Trunk Line 2 — Loading 21% (Rated Current =137A)

Voltage V_{i2}: 9.1kV (17%Drop)

<Branch Line 1>

Load L_{B1}	18A
Line Type	AAC120mm2 No.7
Line Length Len_{B1}	3.2km
Type of Distributed Load	Received Larger
Total Transformer Capacity of secondary substations CAP_{B1}	665kVA

L_{B1} (Distributed or Concentrated Load) (R_{B1} =.9Ω X_{B1} =1.1Ω)

Branch Line 1 — Loading 4% (Rated Current =455A)

Voltage V_{r1}: 10.6kV (4%Drop)

<Branch Line 2>

Load L_{B2}	7A
Line Type	AAC120mm2 No.7
Line Length Len_{B1}	4.6km
Type of Distributed Load	Received Larger
Total Transformer Capacity of secondary substations CAP_{B2}	250kVA

L_{B2} (Distributed or Concentrated Load) (R_{B2} =1.3Ω X_{B2} =1.6Ω)

Branch Line 2 — Loading 1% (Rated Current =455A)

Voltage V_{r2}: 9.1kV (17%Drop)

<Branch Line 3>

Load L_{B3}	12A
Line Type	AAC120mm2 No.7
Line Length Len_{B3}	11.8km
Type of Distributed Load	Received Larger
Total Transformer Capacity of secondary substations CAP_{B3}	450kVA

L_{B3} (Distributed or Concentrated Load) (R_{B3} =3.2Ω X_{B3} =4.2Ω)

Branch Line 3 — Loading 3% (Rated Current =455A)

Voltage V_{r3}: 9.1kV (18%Drop)

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN A
Feeder Name	NEW ASAFO

: Input data in colored cells

Type-2

Maximum Current I_{max}
160.0A

Power factor (cosθ)
0.89

<Trank Line>

Load L_T	74A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_T	2.4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	2245kVA	

<Branch Line 1>

Load L_{B1}	53A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	3.7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	1600kVA	

Primary Substation

→I_{max}

L_T (Distributed Load) (R_T =.4Ω X_T =.3Ω)

Trunk Line

Loading
48%

(Rated Current =335A)

Voltage V_S
11.0kV

Voltage V_i
10.9kV (1%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =.5Ω X_{B1} =.5Ω)

Branch Line 1

Loading
16%

(Rated Current =335A)

Voltage V_{r1}
10.9kV (1%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =.2Ω X_{B2} =.3Ω)

Branch Line 2

Loading
7%

(Rated Current =455A)

Voltage V_{r2}
10.9kV (1%Drop)

<Branch Line 2>

Load L_{B2}	33A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	.9km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	1015kVA	

=====Equation=====

$V_i = V_S - 1.732 \cdot (R_T \cos\theta + X_T \sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage — I_{max} : Maximum Current — R_T, R_{B1}, R_{B2} : Resistance

V_i : Interim Voltage — L_T : Load (Trunk line) — X_T, X_{B1}, X_{B2} : Reactance

V_{r1} : Received Voltage — L_{B1} : Load (Branch Line 1) — cosθ : Power Factor

V_{r2} : Received Voltage — L_{B2} : Load (Branch Line 2) — f_T, f_{B1}, f_{B2} : Dispersal Load Factor — CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	MAIN C
Feeder Name	NSUTA KUMAWU

: Input data in colored cells

Type-3

Maximum Current I_{max}
239.0A

Power factor (cosθ)
0.85

<Trank Line 1>

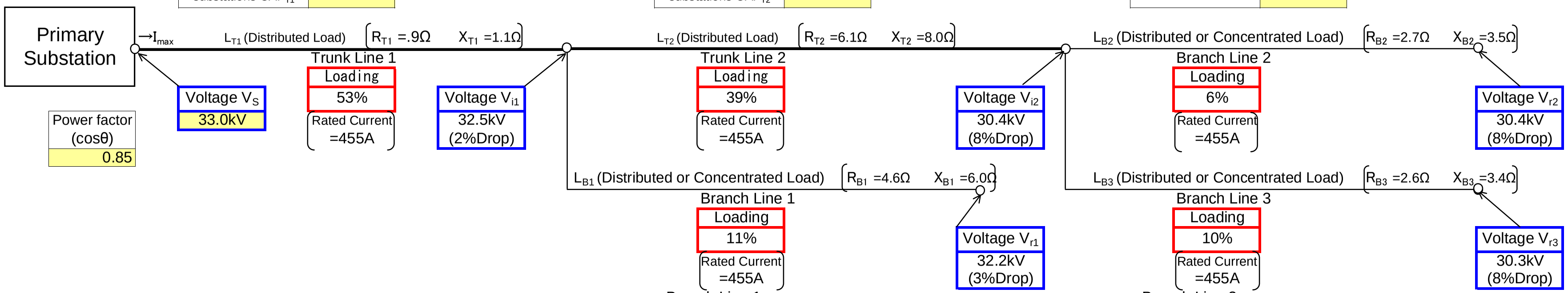
Load L_{T1}	13A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3.2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	200kVA	

<Trank Line 2>

Load L_{T2}	106A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	22.3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1650kVA	

<Branch Line 2>

Load L_{B2}	26A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	9.7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	400kVA	



<Branch Line 1>

Load L_{B1}	50A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	16.9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	775kVA	

<Branch Line 3>

Load L_{B3}	45A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	9.5km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B3}	700kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$, CAP_{B2}, CAP_{B3}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)		
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	NSUTA
Feeder Name	NSUTA

: Input data in colored cells

Type-3

Maximum Current I_{max}
37.0A

Power factor (cosθ)
0.97

<Trank Line 1>

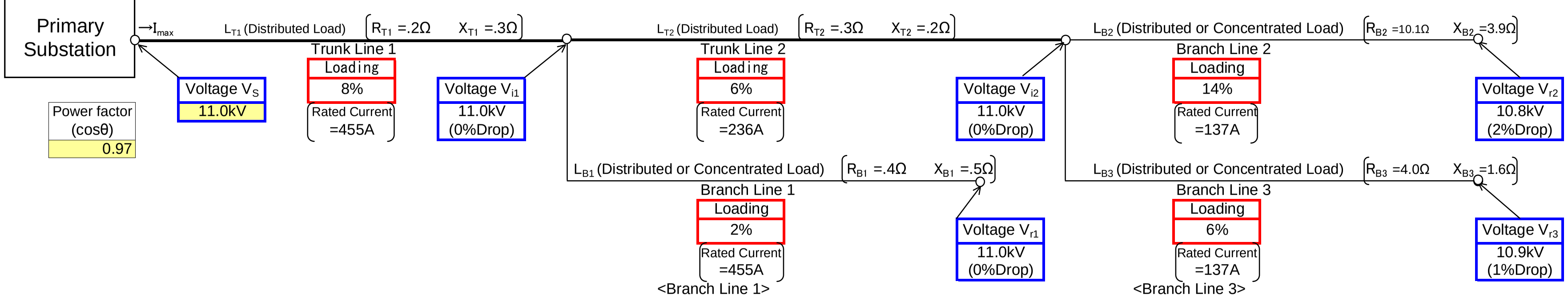
Load L_{T1}	A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	.8km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T1}	kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	Cu35mm2	No.15
Line Legth Len_{T2}	.4km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	19A	
Line Type	Cu16mm2	No.16
Line Length Len_{B1}	7.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	550kVA	



<Branch Line 1>

Load L_{B1}	10A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	1.4km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	300kVA	

<Branch Line 3>

Load L_{B3}	8A	
Line Type	Cu16mm2	No.16
Line Length Len_{B3}	3.1km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B3}	250kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ : Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	MAIN A
Feeder Name	OBR

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	307A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	15.1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	9285kVA	

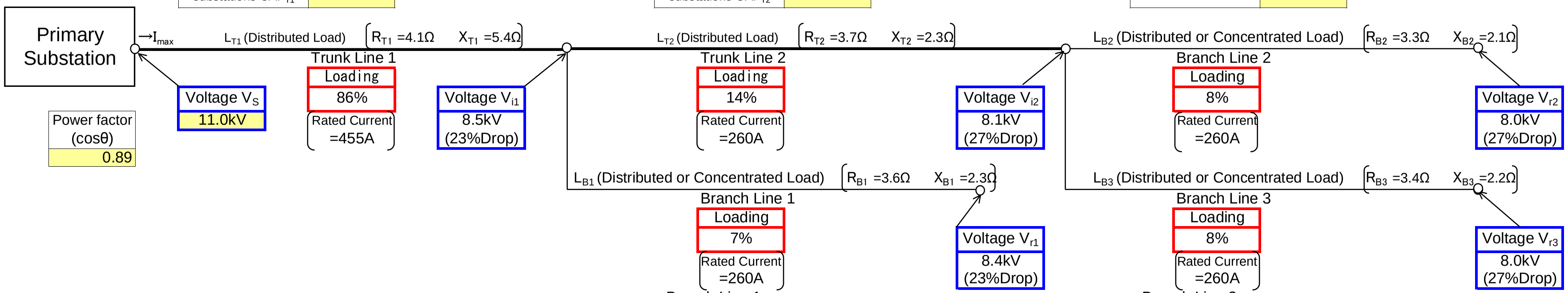
<Trank Line 2>

Load L_{T2}	23A	
Line Type	AAC50mm2	No.11
Line Legth Len_{T2}	6.1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	710kVA	

<Branch Line 2>

Load L_{B2}	20A	
Line Type	AAC50mm2	No.11
Line Length Len_{B1}	5.5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	600kVA	

Maximum Current I_{max}	390.0A
Power factor (cosθ)	0.89



<Branch Line 1>

Load L_{B1}	18A	
Line Type	AAC50mm2	No.11
Line Length Len_{B1}	6.0km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	550kVA	

<Branch Line 3>

Load L_{B3}	21A	
Line Type	AAC50mm2	No.11
Line Length Len_{B3}	5.6km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B3}	650kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast -*

Substation Name	KONONGO
Feeder Name	ODUMASI

: Input data in colored cells

Type-3

<Trank Line 1>		
Load L_{T1}	49A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	42.3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2965kVA	

<Trank Line 2>		
Load L_{T2}	A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	.7km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>		
Load L_{B2}	12A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	1.7km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	730kVA	

Maximum Current I_{max} 75.0A

Power factor (cosθ) 0.85

Primary Substation →I_{max}

Voltage V_S: 11.0kV

L_{T1} (Distributed Load) (R_{T1} =11.6Ω X_{T1} =15.1Ω) — Trunk Line 1: Loading 16%, Rated Current =455A

Voltage V_{i1}: 9.4kV (14%Drop)

L_{T2} (Distributed Load) (R_{T2} =.2Ω X_{T2} =.2Ω) — Trunk Line 2: Loading 4%, Rated Current =455A

Voltage V_{i2}: 9.4kV (14%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =.5Ω X_{B2} =.6Ω) — Branch Line 2: Loading 3%, Rated Current =455A

Voltage V_{r2}: 9.4kV (14%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =2.3Ω X_{B1} =3.0Ω) — Branch Line 1: Loading 2%, Rated Current =455A

Voltage V_{r1}: 9.4kV (15%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =4.0Ω X_{B3} =5.2Ω) — Branch Line 3: Loading 1%, Rated Current =455A

Voltage V_{r3}: 9.4kV (14%Drop)

<Branch Line 1>		
Load L_{B1}	8A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	8.5km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B1}	500kVA	

<Branch Line 3>		
Load L_{B3}	5A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	14.5km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B3}	300kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast -*

Substation Name	BAREKESE
Feeder Name	OFFINSO

: Input data in colored cells

Type-3

Maximum Current I_{max}	144.0A
Power factor (cosθ)	0.85

<Trank Line 1>

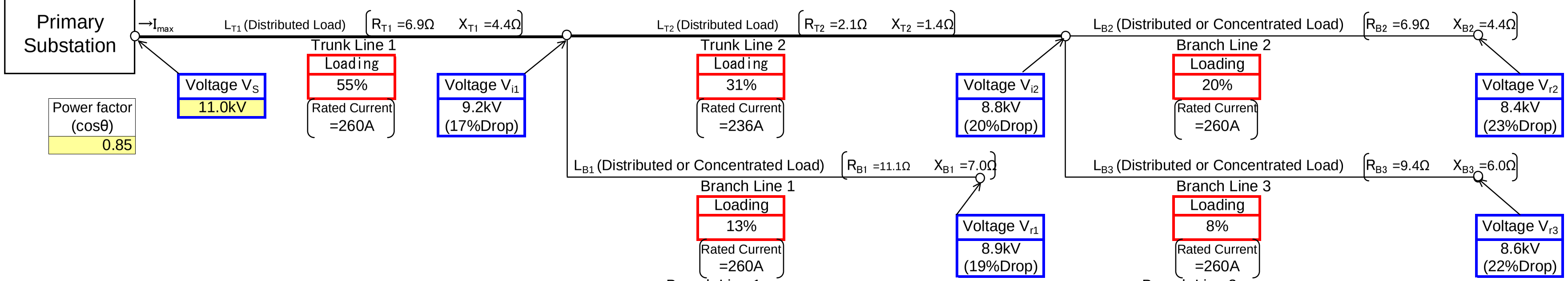
Load L_{T1}	27A	
Line Type	AAC50mm2	No.11
Line Legth Len_{T1}	11.4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1145kVA	

<Trank Line 2>

Load L_{T2}	8A	
Line Type	Cu35mm2	No.15
Line Legth Len_{T2}	3.0km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T2}	315kVA	

<Branch Line 2>

Load L_{B2}	53A	
Line Type	AAC50mm2	No.11
Line Length Len_{B1}	11.4km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	2200kVA	



<Branch Line 1>

Load L_{B1}	35A	
Line Type	AAC50mm2	No.11
Line Length Len_{B1}	18.3km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	1465kVA	

<Branch Line 3>

Load L_{B3}	22A	
Line Type	AAC50mm2	No.11
Line Length Len_{B3}	15.5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	900kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

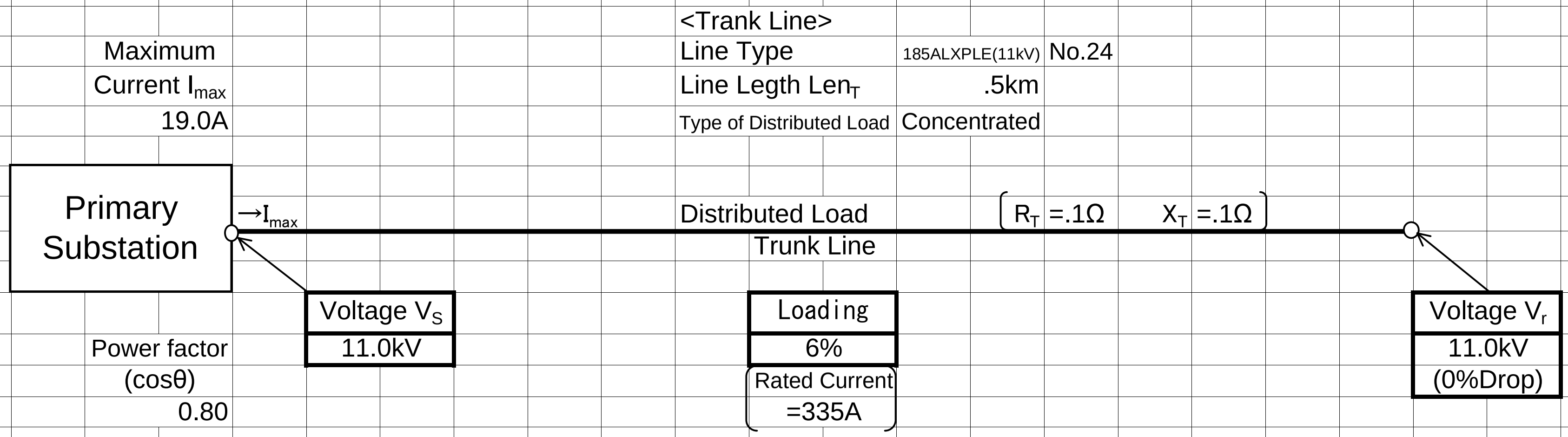
Step A (Type-1)

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	BEKWAI
Feeder Name	PACKAGE

: Input data in colored cells

Type-1



=====Equation=====

$V_r = Vs - 1.732 \cdot I_{max}(R_T \cos\theta + X_T \sin\theta) \cdot f_T$

V_s	: Supply Voltage	R_T	: Resistance	f_T	: Dispersal Load Factor
V_r	: Received Voltage	X_T	: Reactance		
I_{max}	: Maximum Current	cosθ	: Power Factor		

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	MAIN A
Feeder Name	POWER HOUSE 1

: Input data in colored cells

Type-3

Maximum Current I_{max}	350.0A
Power factor (cosθ)	0.89

<Trank Line 1>

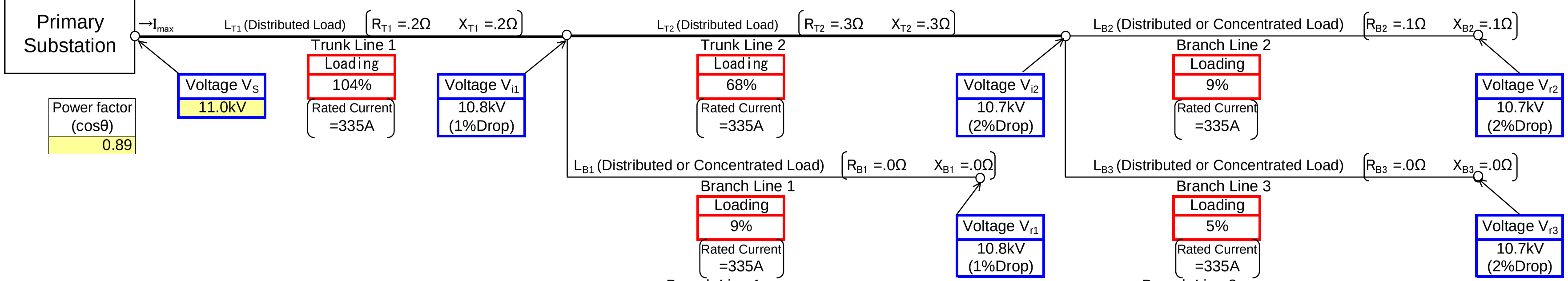
Load L_{T1}	93A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	1.6km	
Type of Distributed Load	Middle Smaller	
Total Transformer Capacity of secondary substations CAP_{T1}	1600kVA	

<Trank Line 2>

Load L_{T2}	181A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	2.2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	3115kVA	

<Branch Line 2>

Load L_{B2}	29A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	.6km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B2}	500kVA	



<Branch Line 1>

Load L_{B1}	29A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	.3km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B1}	500kVA	

<Branch Line 3>

Load L_{B3}	18A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B3}	.1km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B3}	315kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN A
Feeder Name	POWER HOUSE 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
390.0A

Power factor (cosθ)
0.89

<Trank Line 1>

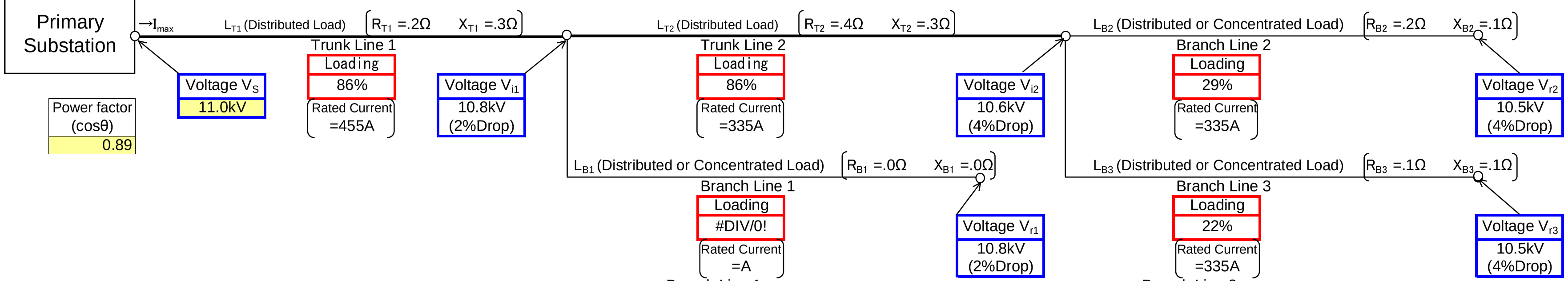
Load L_{T1}	A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	.8km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T1}	kVA	

<Trank Line 2>

Load L_{T2}	218A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	2.4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2915kVA	

<Branch Line 2>

Load L_{B2}	97A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	1.1km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	1300kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Line Length Len_{B1}		
Type of Distributed Load		
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	75A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B3}	.9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	1000kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$,
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN A
Feeder Name	RAIN TREE

: Input data in colored cells

Type-3

Maximum Current I_{max}	
165.0A	

Power factor (cosθ)
0.89

<Trank Line 1>

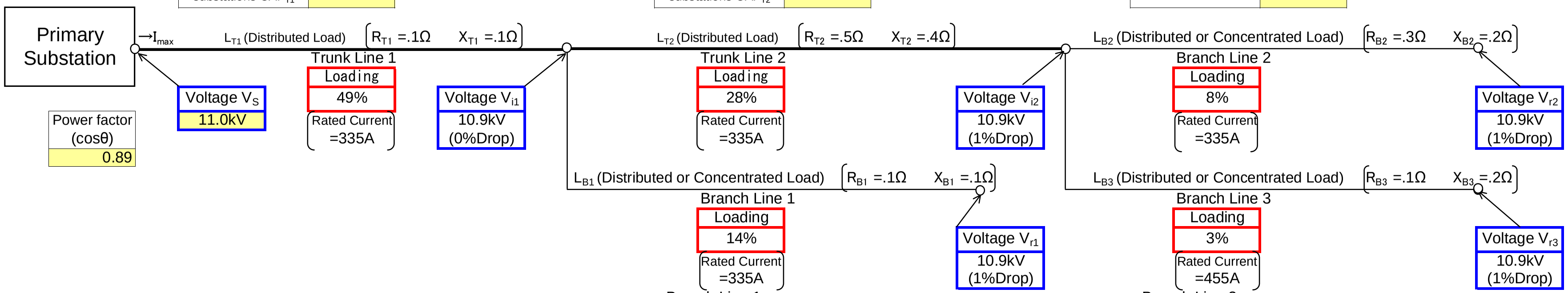
Load L_{T1}	22A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	1.0km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	800kVA	

<Trank Line 2>

Load L_{T2}	54A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	3.4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2000kVA	

<Branch Line 2>

Load L_{B2}	27A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	1.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	1000kVA	



<Branch Line 1>

Load L_{B1}	48A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	.8km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	1760kVA	

<Branch Line 3>

Load L_{B3}	14A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	.5km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B3}	500kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	OBUASI
Feeder Name	STADIUM

: Input data in colored cells

Type-3

Maximum Current I_{max}
94.0A

Power factor (cosθ)
0.85

<Trank Line 1>

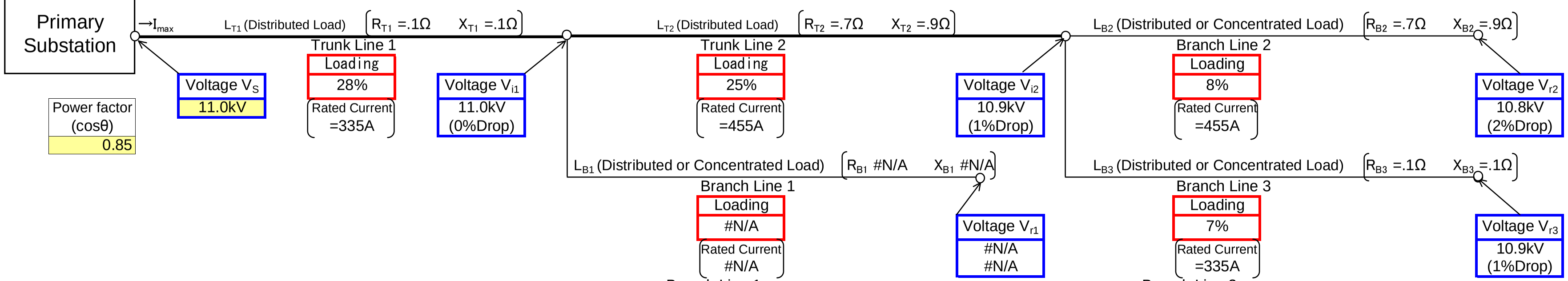
Load L_{T1}	11A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	.6km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T1}	500kVA	

<Trank Line 2>

Load L_{T2}	26A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2.4km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{T2}	1150kVA	

<Branch Line 2>

Load L_{B2}	35A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	2.5km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	1550kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type		#N/A
Line Length Len_{B1}		
Type of Distributed Load		
Total Transformer Capacity of secondary substations CAP_{B1}		

<Branch Line 3>

Load L_{B3}	22A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B3}	.4km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B3}	1000kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	OBUASI
Feeder Name	TUTUKA

: Input data in colored cells

Type-3

Maximum Current I_{max}
200.0A

Power factor (cosθ)
0.85

<Trank Line 1>

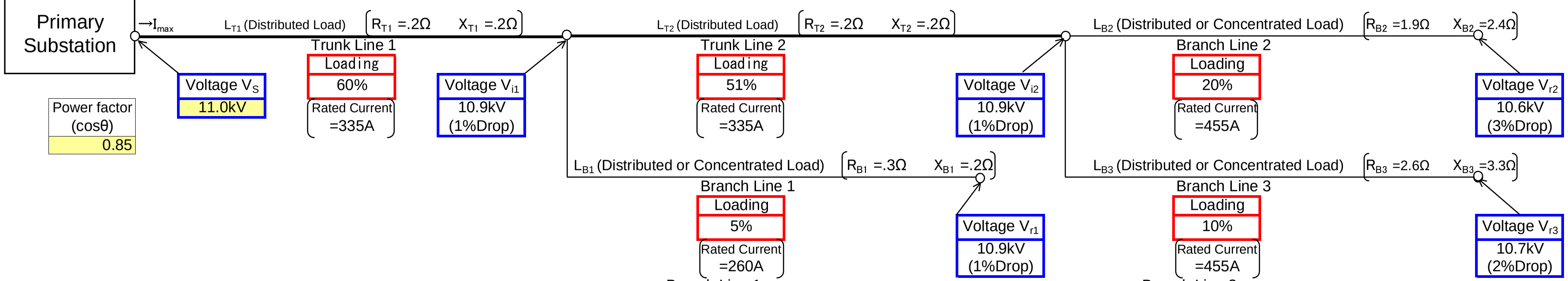
Load L_{T1}	14A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	1.2km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	500kVA	

<Trank Line 2>

Load L_{T2}	37A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	1.4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1300kVA	

<Branch Line 2>

Load L_{B2}	90A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	6.8km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	3160kVA	



<Branch Line 1>

Load L_{B1}	14A	
Line Type	AAC50mm2	No.11
Line Length Len_{B1}	.5km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B1}	500kVA	

<Branch Line 3>

Load L_{B3}	45A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	9.3km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B3}	1600kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN A
Feeder Name	WAHW

: Input data in colored cells

Type-2

Maximum Current I_{max}
140.0A

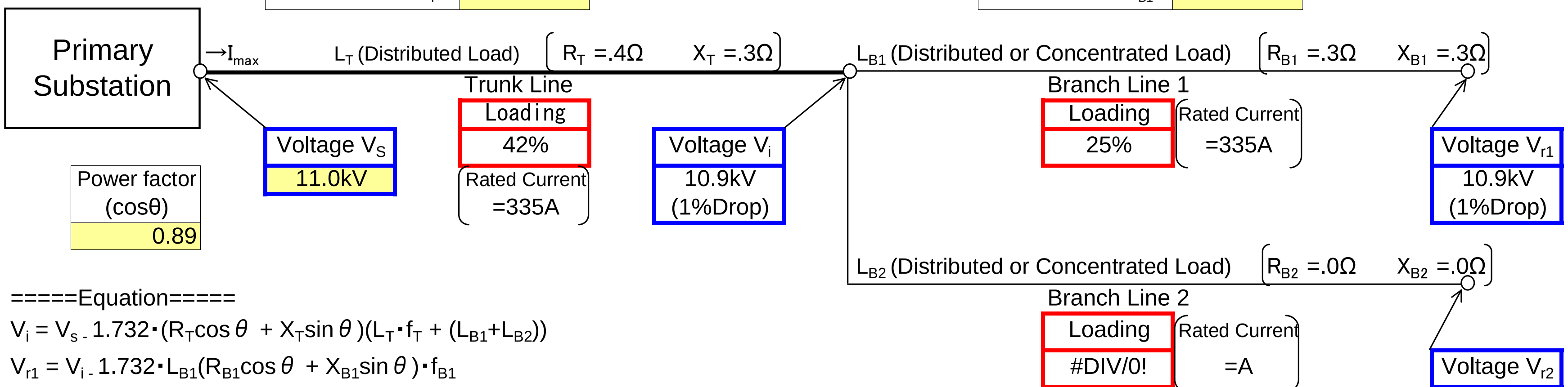
<Trank Line>

Load L_T	57A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_T	2.6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	1600kVA	

<Branch Line 1>

Load L_{B1}	83A	
Line Type	185ALXPLE(11kV)	No.24
Line Length Len_{B1}	2.0km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	2315kVA	

Power factor (cosθ)
0.89



<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Line Length Len_{B1}		
Type of Distributed Load		
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

=====Equation=====

$V_i = V_S - 1.732 \cdot (R_T\cos\theta + X_T\sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage
V_i : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage

I_{max} : Maximum Current
L_T : Load (Trunk line)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)

R_T, R_{B1}, R_{B2} : Resistance
X_T, X_{B1}, X_{B2} : Reactance
cosθ : Power Factor
f_T, f_{B1}, f_{B2} : Dispersal Load Factor
CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	BEKWAI
Feeder Name	WATERWORKS

: Input data in colored cells

Type-2

<Trank Line>

Load L_T	23A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	12.2km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_T	900kVA	

<Branch Line 1>

Load L_{B1}	8A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	6.1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	300kVA	

Maximum Current I_{max}: 39.0A

Power factor ($\cos\theta$): 0.80

Primary Substation →I_{max}

Voltage V_S: 11.0kV

L_T (Distributed Load) (R_T =3.3Ω X_T =4.4Ω)

Trunk Line — Loading: 9% — Rated Current =455A

Voltage V_i: 10.8kV (2%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =1.7Ω X_{B1} =2.2Ω)

Branch Line 1 — Loading: 2% — Rated Current =455A

Voltage V_{r1}: 10.8kV (2%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =1.8Ω X_{B2} =2.4Ω)

Branch Line 2 — Loading: 2% — Rated Current =455A

Voltage V_{r2}: 10.8kV (2%Drop)

<Branch Line 2>

Load L_{B2}	8A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	6.7km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	300kVA	

=====Equation=====

$V_i = V_S - 1.732 \cdot (R_T\cos\theta + X_T\sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_T, R_{B1}, R_{B2}	: Resistance		
V_i	: Interim Voltage	L_T	: Load (Trunk line)	X_T, X_{B1}, X_{B2}	: Reactance		
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$\cos\theta$	: Power Factor		
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	f_T, f_{B1}, f_{B2}	: Dispersal Load Factor	CAP_T, CAP_{B1}, CAP_{B2}	: Total Transformer Capacity of secondary substations

Power System Analysis

- Ashanti 33kV -

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	MAIN B
Feeder Name	BAREKESE 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
70.0A

Power factor (cosθ)
0.97

Primary Substation →I_{max}

Voltage V_S
33.0kV

<Trank Line 1>

Load L_{T1}	2A	
Line Type	AAC150mm2	No.6
Line Legth Len_{T1}	12.7km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T1}	150kVA	

L_{T1} (Distributed Load) (R_{T1} =2.6Ω X_{T1} =4.4Ω)

Trunk Line 1: Loading 13% (Rated Current =530A)

Voltage V_{i1}
32.6kV (1%Drop)

<Trank Line 2>

Load L_{T2}	4A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	8.2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	350kVA	

L_{T2} (Distributed Load) (R_{T2} =2.2Ω X_{T2} =2.9Ω)

Trunk Line 2: Loading 11% (Rated Current =455A)

Voltage V_{i2}
32.3kV (2%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =2.0Ω X_{B1} =3.5Ω)

Branch Line 1: Loading 1% (Rated Current =530A)

Voltage V_{r1}
32.5kV (1%Drop)

<Branch Line 1>

Load L_{B1}	8A	
Line Type	AAC150mm2	No.6
Line Length Len_{B1}	9.9km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	675kVA	

<Branch Line 2>

Load L_{B2}	28A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	21.4km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	2465kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =5.9Ω X_{B2} =7.6Ω)

Branch Line 2: Loading 6% (Rated Current =455A)

Voltage V_{r2}
32.1kV (3%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =.0Ω X_{B3} =.0Ω)

Branch Line 3: Loading 5% (Rated Current =530A)

Voltage V_{r3}
32.3kV (2%Drop)

<Branch Line 3>

Load L_{B3}	29A	
Line Type	AAC150mm2	No.6
Line Length Len_{B3}		
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B3}	2500kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

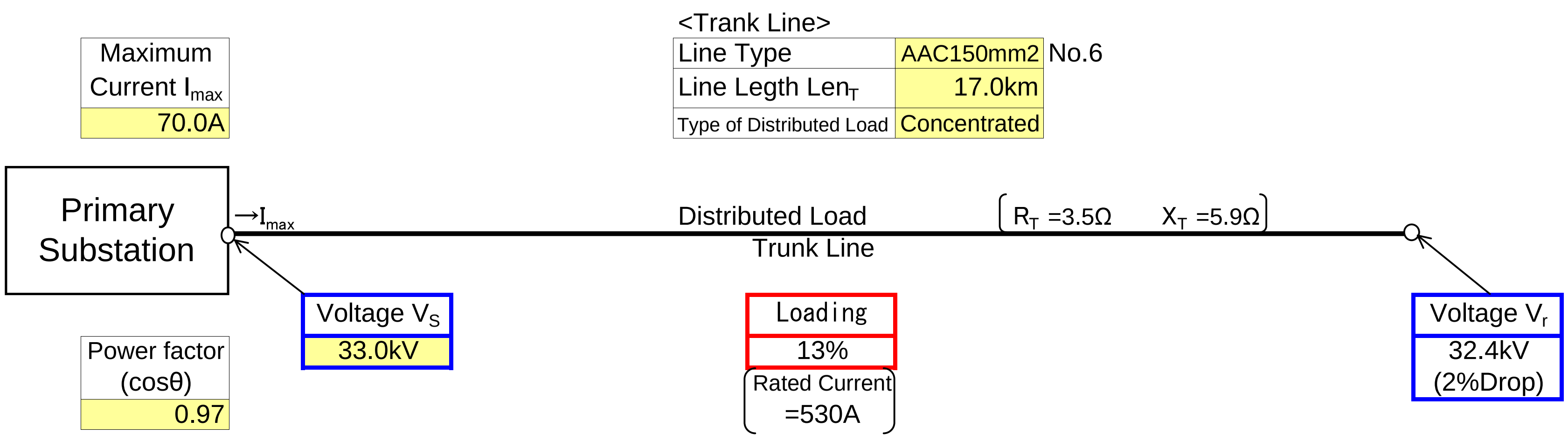
V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN B
Feeder Name	BAREKESE 2

: Input data in colored cells

Type-1



=====Equation=====

$V_r = Vs - 1.732 \cdot I_{max}(R_T \cos\theta + X_T \sin\theta) \cdot f_T$

V_s	: Supply Voltage	R_T	: Resistance	f_T	: Dispersal Load Factor
V_r	: Received Voltage	X_T	: Reactance		
I_{max}	: Maximum Current	cosθ	: Power Factor		

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	MAIN B
Feeder Name	BAREKESE 2

: Input data in colored cells

Type-2

Maximum Current I_{max}: 104.0A

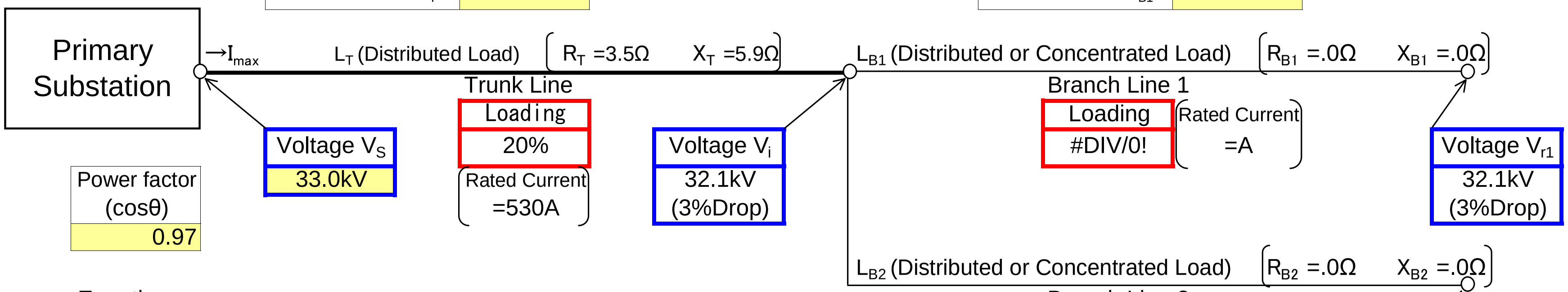
Power factor (cosθ): 0.97

<Trank Line>

Load L_T	104A	
Line Type	AAC150mm2	No.6
Line Legth Len_T	17.0km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_T	7500kVA	

<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Line Length Len_{B1}		
Type of Distributed Load		
Total Transformer Capacity of secondary substations CAP_{B1}		



<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Line Length Len_{B1}		
Type of Distributed Load		
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

=====Equation=====

$V_i = V_S - 1.732 \cdot (R_T\cos\theta + X_T\sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage
V_i : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
I_{max} : Maximum Current
L_T : Load (Trunk line)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
R_T, R_{B1}, R_{B2} : Resistance
X_T, X_{B1}, X_{B2} : Reactance
cosθ : Power Factor
f_T, f_{B1}, f_{B2} : Dispersal Load Factor
CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	STATION D
Feeder Name	BEKWAI 33KV

: Input data in colored cells

Type-3

Maximum Current I_{max}
100.0A

Power factor (cosθ)
0.80

<Trank Line 1>

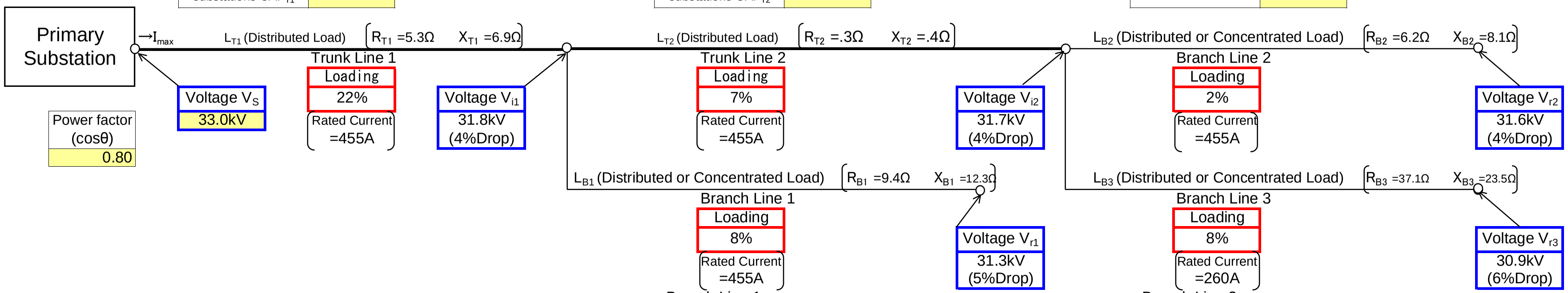
Load L_{T1}	28A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	19.3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	3100kVA	

<Trank Line 2>

Load L_{T2}	2A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	1.1km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T2}	200kVA	

<Branch Line 2>

Load L_{B2}	11A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	22.6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	1200kVA	



<Branch Line 1>

Load L_{B1}	38A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	34.4km	
Type of Distributed Load	Middle Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	4175kVA	

<Branch Line 3>

Load L_{B3}	21A	
Line Type	AAC50mm2	No.11
Line Length Len_{B3}	61.1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	2300kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	AGONA
Feeder Name	KUMAWU

: Input data in colored cells

Type-3

Maximum Current I_{max}
126.0A

Power factor (cosθ)
0.82

<Trank Line 1>

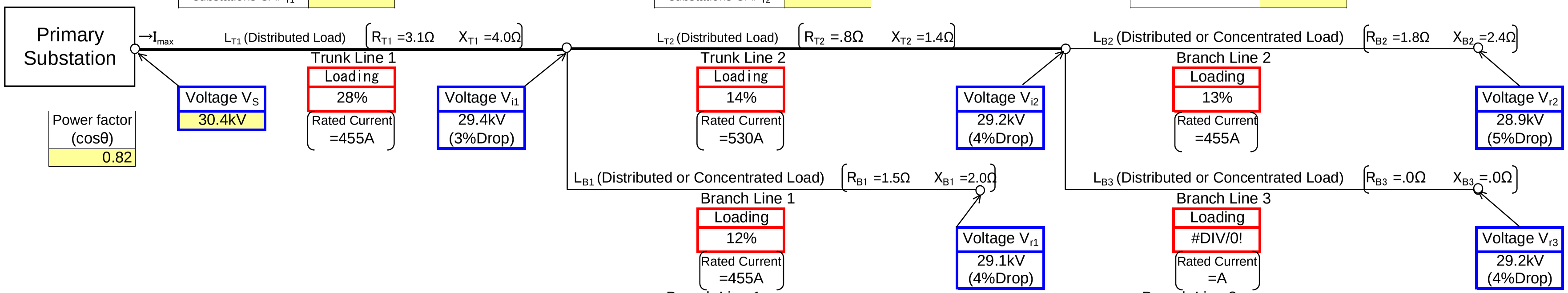
Load L_{T1}	3A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	11.3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	300kVA	

<Trank Line 2>

Load L_{T2}	6A	
Line Type	AAC150mm2	No.6
Line Legth Len_{T2}	3.9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	500kVA	

<Branch Line 2>

Load L_{B2}	57A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	6.7km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B2}	5050kVA	



<Branch Line 1>

Load L_{B1}	57A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	5.5km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B1}	5000kVA	

<Branch Line 3>

Load L_{B3}	3A	
Line Type	None	No.33
Line Length Len_{B3}	6.0km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	250kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$, CAP_{B2}, CAP_{B3}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)		
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	MAIN B
Feeder Name	MANSO NKWANTA

: Input data in colored cells

Type-3

Maximum Current I_{max}
30.0A

Power factor (cosθ)
0.97

<Trank Line 1>

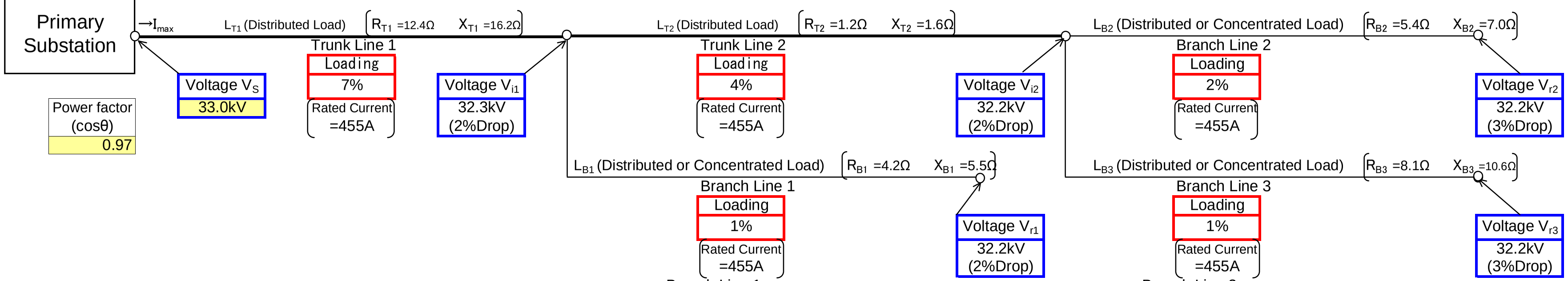
Load L_{T1}	6A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	45.3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1550kVA	

<Trank Line 2>

Load L_{T2}	5A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	4.4km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T2}	1250kVA	

<Branch Line 2>

Load L_{B2}	8A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	19.6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	2050kVA	



<Branch Line 1>

Load L_{B1}	7A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	15.3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	1700kVA	

<Branch Line 3>

Load L_{B3}	4A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	29.7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	1050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	OBUASI
Feeder Name	NEW EDUBIASE

: Input data in colored cells

Type-3

Maximum Current I_{max}	31.0A
Power factor (cosθ)	0.85

<Trank Line 1>

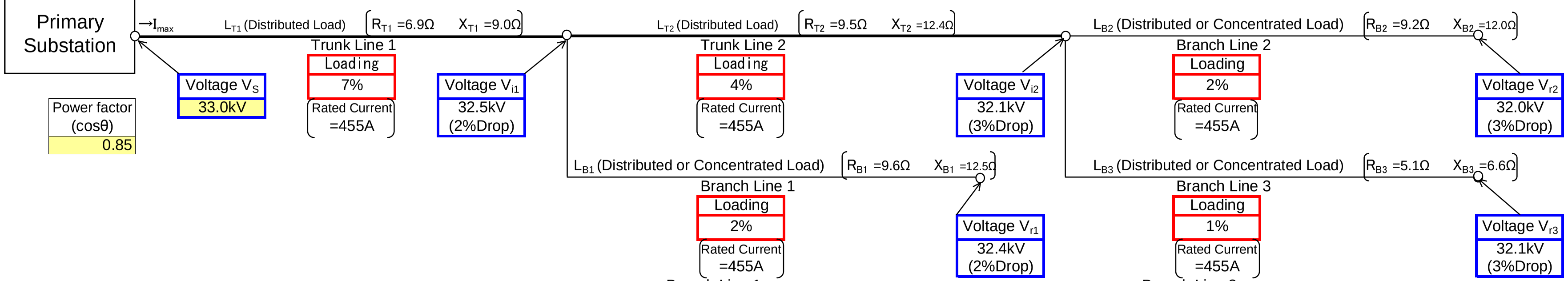
Load L_{T1}	6A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	25.3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	750kVA	

<Trank Line 2>

Load L_{T2}	4A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	34.8km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	550kVA	

<Branch Line 2>

Load L_{B2}	10A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	33.7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B2}	1250kVA	



<Branch Line 1>

Load L_{B1}	8A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	35.0km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B1}	1000kVA	

<Branch Line 3>

Load L_{B3}	3A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	18.5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{B3}	450kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	AGONA
Feeder Name	NSUTA 33KV

: Input data in colored cells

Type-3

Maximum Current I_{max}
203.0A

Power factor (cosθ)
0.82

<Trank Line 1>

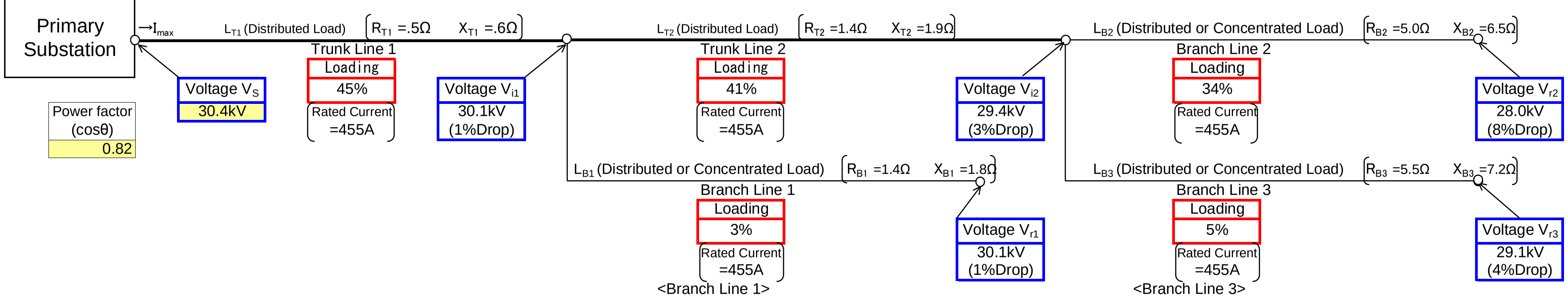
Load L_{T1}	6A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	1.8km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T1}	200kVA	

<Trank Line 2>

Load L_{T2}	6A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	5.2km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{T2}	200kVA	

<Branch Line 2>

Load L_{B2}	157A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	18.2km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{B2}	5700kVA	



<Branch Line 1>

Load L_{B1}	12A	
Line Type	AAC120mm2	No.7
Line Length Len_{B1}	5.0km	
Type of Distributed Load	Sending Larger	
Total Transformer Capacity of secondary substations CAP_{B1}	425kVA	

<Branch Line 3>

Load L_{B3}	23A	
Line Type	AAC120mm2	No.7
Line Length Len_{B3}	20.2km	
Type of Distributed Load	Concentrated	
Total Transformer Capacity of secondary substations CAP_{B3}	850kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis

- Central -

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	SALTPOND
Feeder Name	ANOMABO

: Input data in colored cells

Type-3

Maximum Current I_{max}	38A
Power factor (cosθ)	0.86

Primary Substation →I_{max}

<Trank Line 1>

Load L_{T1}	38A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1350kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	None	No.33
Line Legth Len_{T2}	km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{T1} (Distributed Load) (R_{T1} =3Ω X_{T1} =3Ω)
Trunk Line 1: Loading 8%; Rated Current =455A
Voltage V_S: 11.5kV
Voltage V_{i1}: 11.4kV (1%Drop)

L_{T2} (Distributed Load) (R_{T2} =Ω X_{T2} =Ω)
Trunk Line 2: Loading 0%; Rated Current =A
Voltage V_{i2}: 11.4kV (1%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)
Branch Line 2: Loading #DIV/0!; Rated Current =A
Voltage V_{r2}: 11.4kV (1%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)
Branch Line 1: Loading #DIV/0!; Rated Current =A
Voltage V_{r1}: 11.4kV (1%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)
Branch Line 3: Loading #DIV/0!; Rated Current =A
Voltage V_{r3}: 11.4kV (1%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	ANOMABO

: Input data in colored cells

Type-3

Maximum Current I_{max}
40A

Power factor (cosθ)
0.86

<Trank Line 1>

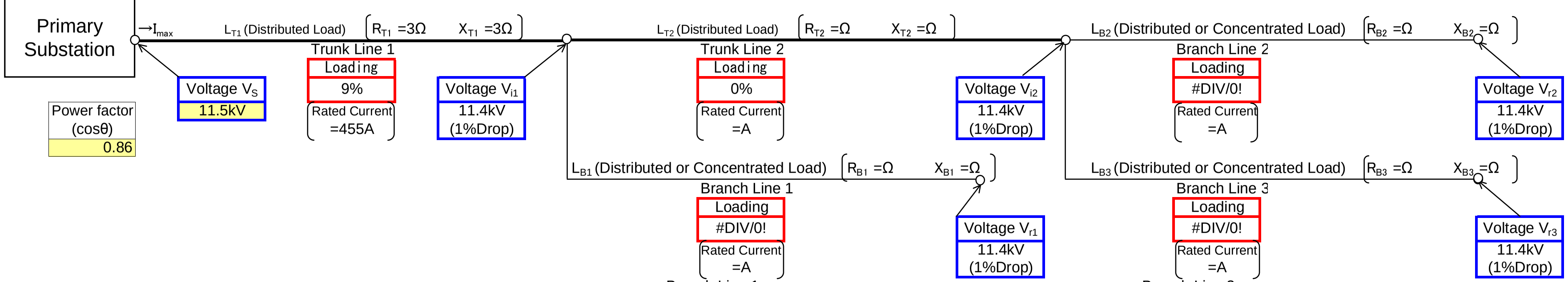
Load L_{T1}	40A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1350kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	None	No.33
Line Legth Len_{T2}	km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	ANOMABO

: Input data in colored cells

Type-3

Maximum Current I_{max}
43A

Power factor ($\cos\theta$)
0.86

<Trank Line 1>

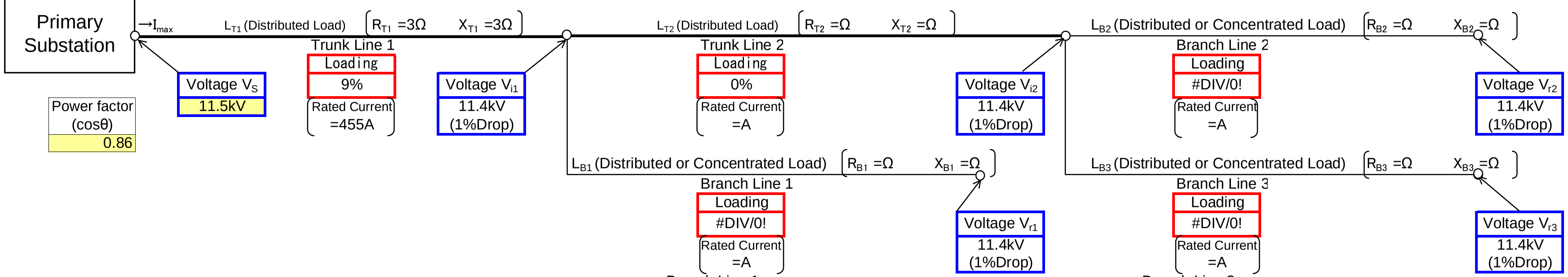
Load L_{T1}	43A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1350kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	None	No.33
Line Legth Len_{T2}	km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage
V_{i1} : Interim Voltage
V_{i2} : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
V_{r3} : Received Voltage

I_{max} : Maximum Current
L_{T1} : Load (Trunk line 1)
L_{T2} : Load (Trunk line 2)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
L_{B3} : Load (Branch Line 3)

$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
$CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3}$: Total Transformer Capacity of secondary substations
$\cos\theta$: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	ANOMABO

: Input data in colored cells

Type-3

Maximum Current I_{max}
45A

Power factor (cosθ)
0.86

<Trank Line 1>

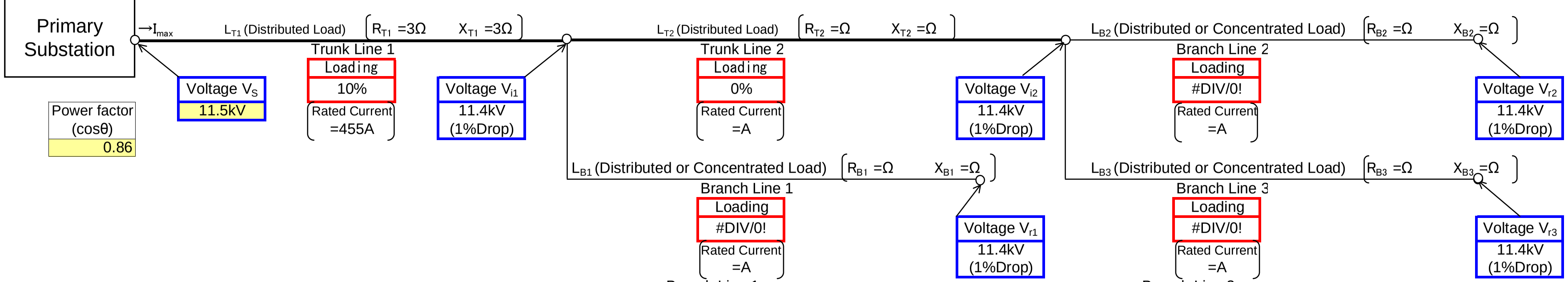
Load L_{T1}	45A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1350kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	None	No.33
Line Legth Len_{T2}	km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	ANOMABO

: Input data in colored cells

Type-3

Maximum Current I_{max}
48A

Power factor (cosθ)
0.86

<Trank Line 1>

Load L_{T1}	48A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1350kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	None	No.33
Line Legth Len_{T2}	km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Primary Substation →I_{max}

L_{T1} (Distributed Load) (R_{T1} =3Ω X_{T1} =3Ω)

Voltage V_S: 11.5kV

Trunk Line 1: Loading 11%; Rated Current =455A

Voltage V_{i1}: 11.3kV (1%Drop)

L_{T2} (Distributed Load) (R_{T2} =Ω X_{T2} =Ω)

Trunk Line 2: Loading 0%; Rated Current =A

Voltage V_{i2}: 11.3kV (1%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2: Loading #DIV/0!; Rated Current =A

Voltage V_{r2}: 11.3kV (1%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1: Loading #DIV/0!; Rated Current =A

Voltage V_{r1}: 11.3kV (1%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!; Rated Current =A

Voltage V_{r3}: 11.3kV (1%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	SALTPOND
Feeder Name	ANOMABO

: Input data in colored cells

Type-3

Maximum Current I_{max}	50A
Power factor (cosθ)	0.86

<Trank Line 1>

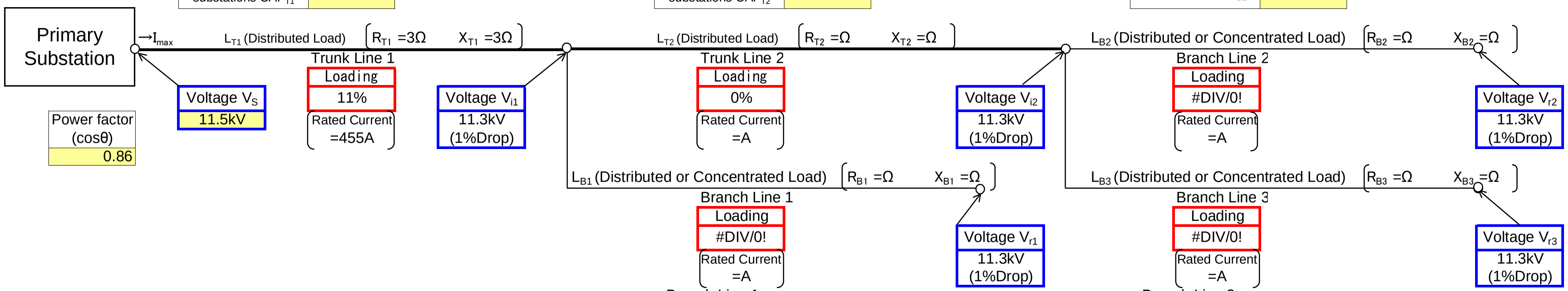
Load L_{T1}	50A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1350kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	None	No.33
Line Legth Len_{T2}	km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	SALTPOND
Feeder Name	ANOMABO

: Input data in colored cells

Type-3

Maximum Current I_{max}: 53A

Power factor ($\cos\theta$): 0.86

<Trank Line 1>

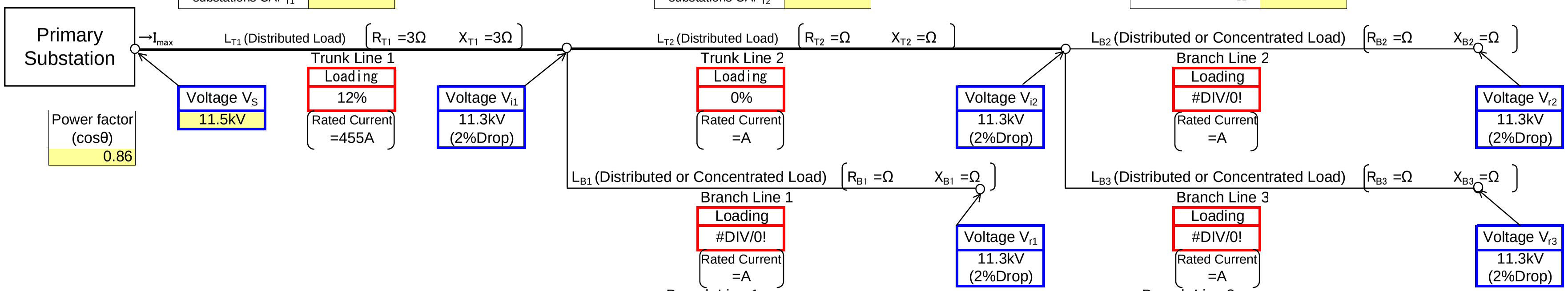
Load L_{T1}	53A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1350kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	None	No.33
Line Legth Len_{T2}	km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	$\cos\theta$	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	ANOMABO

: Input data in colored cells

Type-3

Maximum Current I_{max}
56A

Power factor ($\cos\theta$)
0.86

<Trank Line 1>

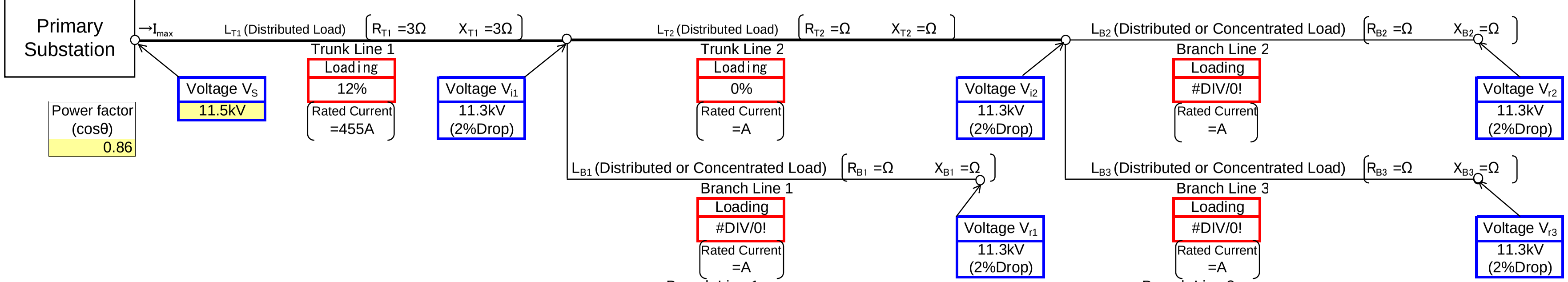
Load L_{T1}	56A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1350kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	None	No.33
Line Legth Len_{T2}	km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	$\cos\theta$	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	ANOMABO

: Input data in colored cells

Type-3

Maximum Current I_{max}
60A

Power factor (cosθ)
0.86

<Trank Line 1>

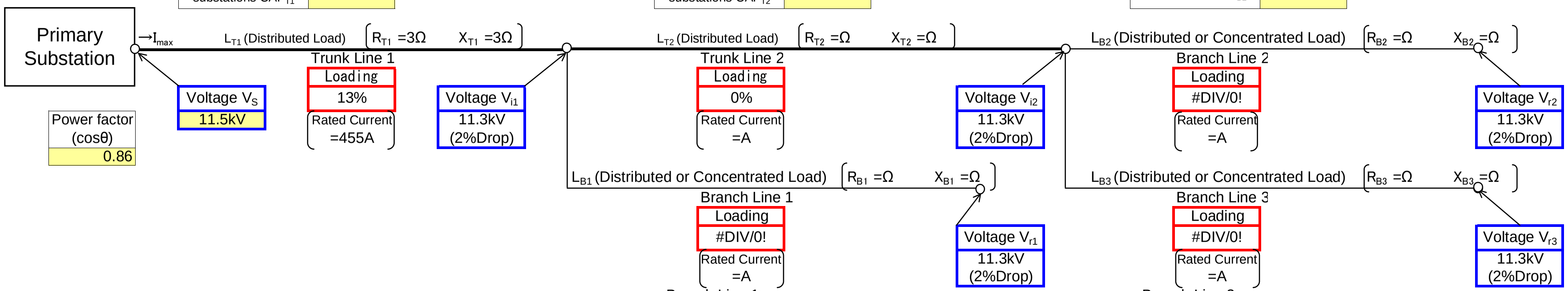
Load L_{T1}	60A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1350kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	None	No.33
Line Legth Len_{T2}	km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	SALTPOND
Feeder Name	ANOMABO

: Input data in colored cells

Type-3

Maximum Current I_{max}	63A
Power factor (cosθ)	0.86

Primary Substation →I_{max}

Voltage V_S: 11.5kV

<Trank Line 1>

Load L_{T1}	63A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1350kVA	

L_{T1} (Distributed Load) (R_{T1} =3Ω X_{T1} =3Ω)

Trunk Line 1: Loading 14%; Rated Current =455A

Voltage V_{i1}: 11.3kV (2%Drop)

<Trank Line 2>

Load L_{T2}	A	
Line Type	None	No.33
Line Legth Len_{T2}	km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

L_{T2} (Distributed Load) (R_{T2} =Ω X_{T2} =Ω)

Trunk Line 2: Loading 0%; Rated Current =A

Voltage V_{i2}: 11.3kV (2%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2: Loading #DIV/0!; Rated Current =A

Voltage V_{r2}: 11.3kV (2%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1: Loading #DIV/0!; Rated Current =A

Voltage V_{r1}: 11.3kV (2%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!; Rated Current =A

Voltage V_{r3}: 11.3kV (2%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

- V_s : Supply Voltage
- V_{i1} : Interim Voltage
- V_{i2} : Interim Voltage
- V_{r1} : Received Voltage
- V_{r2} : Received Voltage
- V_{r3} : Received Voltage
- I_{max} : Maximum Current
- L_{T1} : Load (Trunk line 1)
- L_{T2} : Load (Trunk line 2)
- L_{B1} : Load (Branch Line 1)
- L_{B2} : Load (Branch Line 2)
- L_{B3} : Load (Branch Line 3)
- R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3} : Resistance
- X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3} : Reactance
- f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3} : Dispersal Load Factor
- CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
- cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	ANOMABO

: Input data in colored cells

Type-3

Maximum Current I_{max}	67A
Power factor ($\cos\theta$)	0.86

Primary Substation

→I_{max}

Voltage V_S: 11.5kV

<Trank Line 1>

Load L_{T1}	67A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1350kVA	

L_{T1} (Distributed Load) (R_{T1} =3Ω X_{T1} =3Ω)

Trunk Line 1: Loading 15%, Rated Current =455A

Voltage V_{i1}: 11.3kV (2%Drop)

<Trank Line 2>

Load L_{T2}	A	
Line Type	None	No.33
Line Legth Len_{T2}	km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

L_{T2} (Distributed Load) (R_{T2} =Ω X_{T2} =Ω)

Trunk Line 2: Loading 0%, Rated Current =A

Voltage V_{i2}: 11.3kV (2%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2: Loading #DIV/0!, Rated Current =A

Voltage V_{r2}: 11.3kV (2%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1: Loading #DIV/0!, Rated Current =A

Voltage V_{r1}: 11.3kV (2%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!, Rated Current =A

Voltage V_{r3}: 11.3kV (2%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	$\cos\theta$	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	SALTPOND
Feeder Name	ANOMABO

: Input data in colored cells

Type-3

Maximum Current I_{max}
71A

Power factor (cosθ)
0.86

<Trank Line 1>

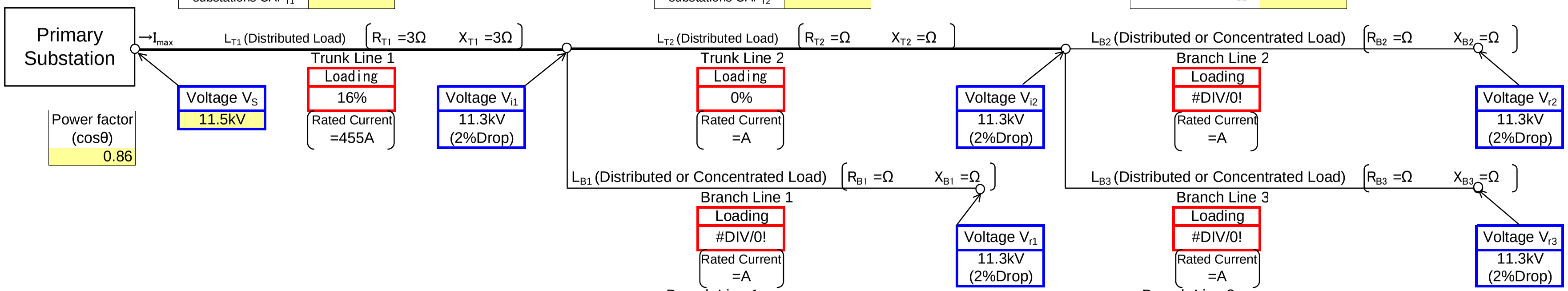
Load L_{T1}	71A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1350kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	None	No.33
Line Legth Len_{T2}	km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

- V_s : Supply Voltage
- V_{i1} : Interim Voltage
- V_{i2} : Interim Voltage
- V_{r1} : Received Voltage
- V_{r2} : Received Voltage
- V_{r3} : Received Voltage
- I_{max} : Maximum Current
- L_{T1} : Load (Trunk line 1)
- L_{T2} : Load (Trunk line 2)
- L_{B1} : Load (Branch Line 1)
- L_{B2} : Load (Branch Line 2)
- L_{B3} : Load (Branch Line 3)
- R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3} : Resistance
- X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3} : Reactance
- f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3} : Dispersal Load Factor
- CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
- cosθ : Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P
Feeder Name	APAM

: Input data in colored cells

Type-3

Maximum Current I_{max}
120A

Power factor (cosθ)
0.86

<Trank Line 1>

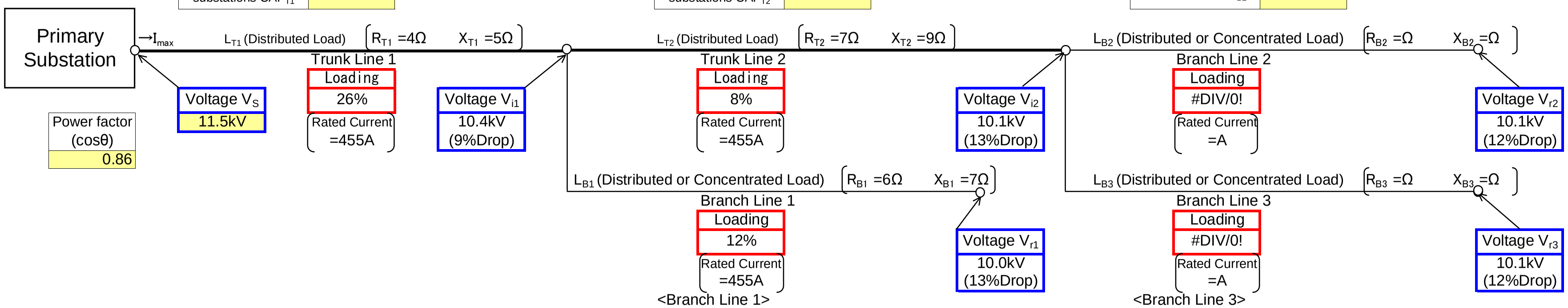
Load L_{T1}	29A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1465kVA	

<Trank Line 2>

Load L_{T2}	37A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	24km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	54A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	2765kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P
Feeder Name	APAM

: Input data in colored cells

Type-3

Maximum Current I_{max}	126A

Power factor (cosθ)	0.86

<Trank Line 1>

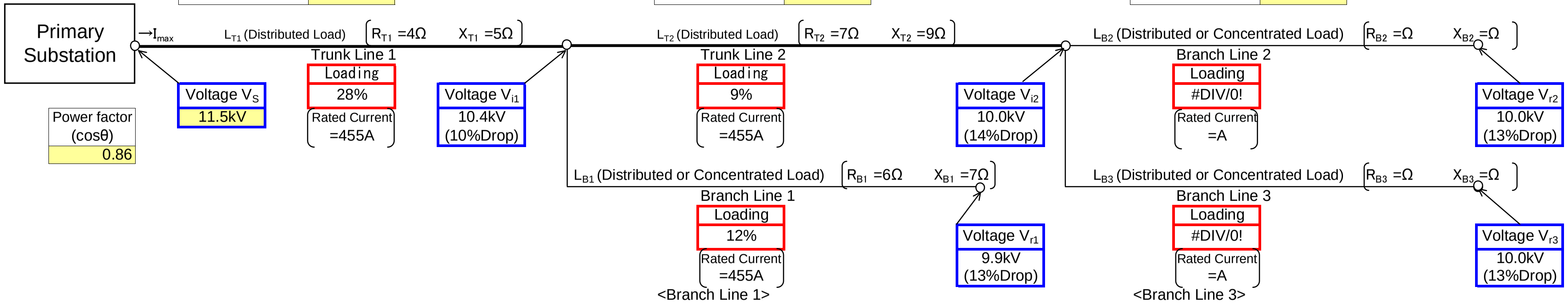
Load L_{T1}	30A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1465kVA	

<Trank Line 2>

Load L_{T2}	39A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	24km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	57A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	2765kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P
Feeder Name	APAM

: Input data in colored cells

Type-3

Maximum Current I_{max}
133A

Power factor (cosθ)
0.86

<Trank Line 1>

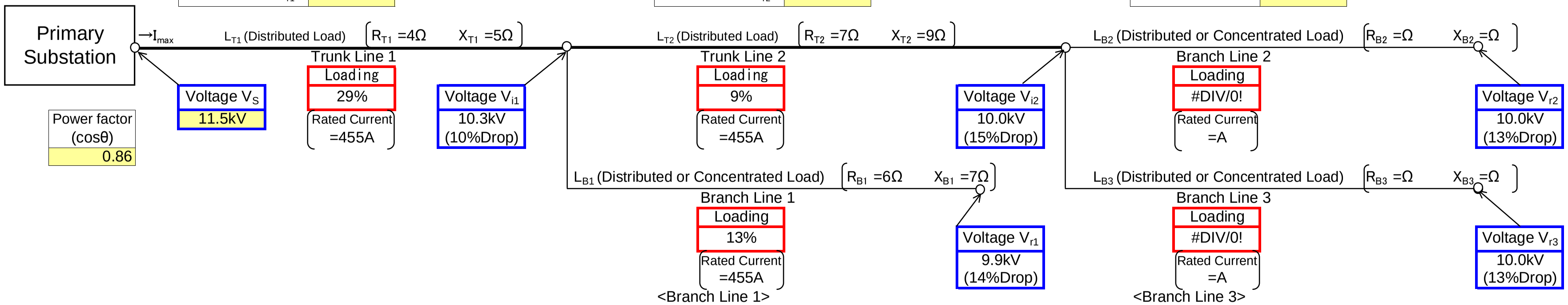
Load L_{T1}	32A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1465kVA	

<Trank Line 2>

Load L_{T2}	41A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	24km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	60A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	2765kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P
Feeder Name	APAM

: Input data in colored cells

Type-3

Maximum Current I_{max}: 140A

Power factor (cosθ): 0.86

<Trank Line 1>

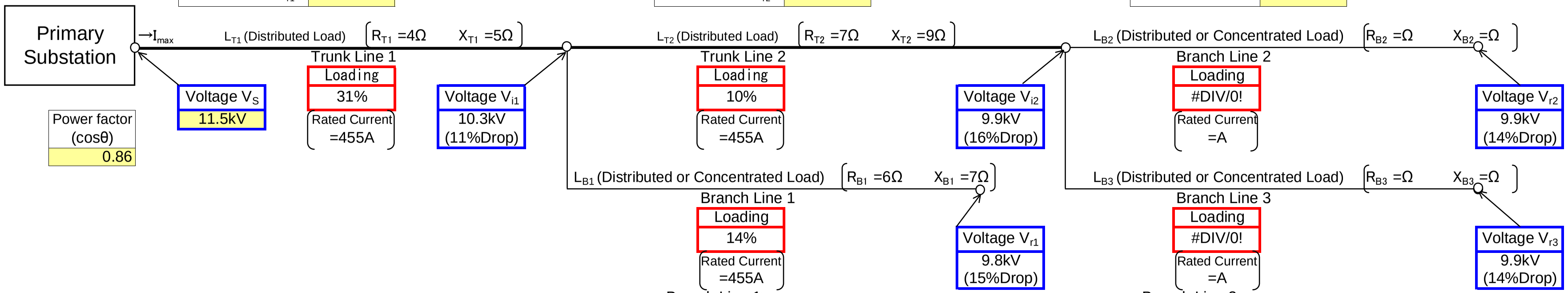
Load L_{T1}	33A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1465kVA	

<Trank Line 2>

Load L_{T2}	43A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	24km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	63A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	2765kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P
Feeder Name	APAM

: Input data in colored cells

Type-3

Maximum Current I_{max}
147A

Power factor (cosθ)
0.86

<Trank Line 1>

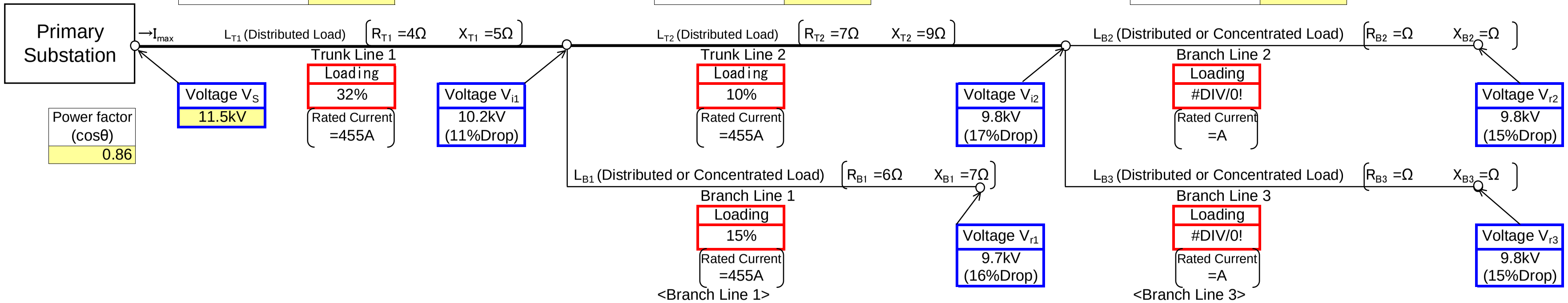
Load L_{T1}	35A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1465kVA	

<Trank Line 2>

Load L_{T2}	46A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	24km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	66A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	2765kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P
Feeder Name	APAM

: Input data in colored cells

Type-3

Maximum Current I_{max}
154A

Power factor (cosθ)
0.86

<Trank Line 1>

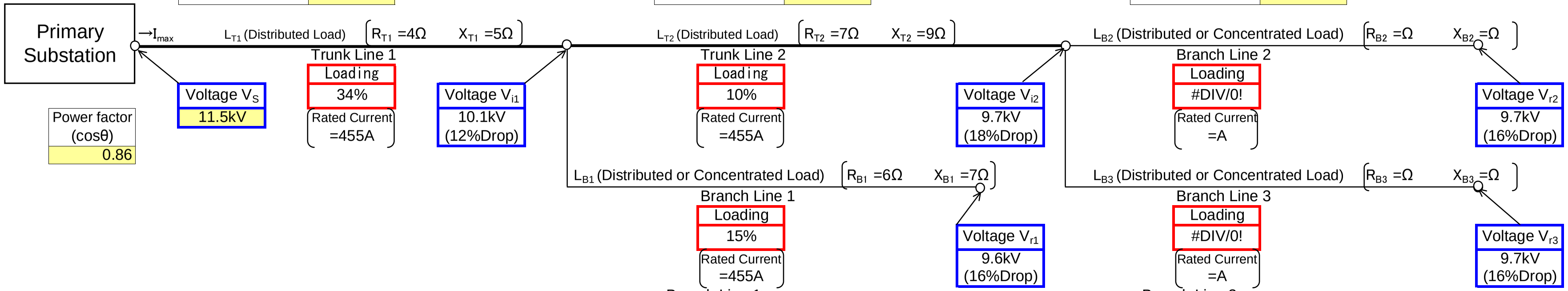
Load L_{T1}	37A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1465kVA	

<Trank Line 2>

Load L_{T2}	48A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	24km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	69A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	2765kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P
Feeder Name	APAM

: Input data in colored cells

Type-3

Maximum Current I_{max}
162A

Primary Substation

Power factor (cosθ)
0.86

Voltage V_s
11.5kV

<Trank Line 1>

Load L_{T1}	39A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1465kVA	

$\rightarrow I_{max}$ L_{T1} (Distributed Load) (R_{T1} =4Ω X_{T1} =5Ω)

Trunk Line 1: Loading 36% (Rated Current =455A)

Voltage V_{i1}
10.1kV (13%Drop)

<Trank Line 2>

Load L_{T2}	50A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	24km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

L_{T2} (Distributed Load) (R_{T2} =7Ω X_{T2} =9Ω)

Trunk Line 2: Loading 11% (Rated Current =455A)

Voltage V_{i2}
9.6kV (19%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =6Ω X_{B1} =7Ω)

Branch Line 1: Loading 16% (Rated Current =455A)

Voltage V_{r1}
9.5kV (17%Drop)

<Branch Line 1>

Load L_{B1}	73A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	2765kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2: Loading #DIV/0! (Rated Current =A)

Voltage V_{r2}
9.6kV (16%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0! (Rated Current =A)

Voltage V_{r3}
9.6kV (16%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P
Feeder Name	APAM

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	41A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1465kVA	

<Trank Line 2>

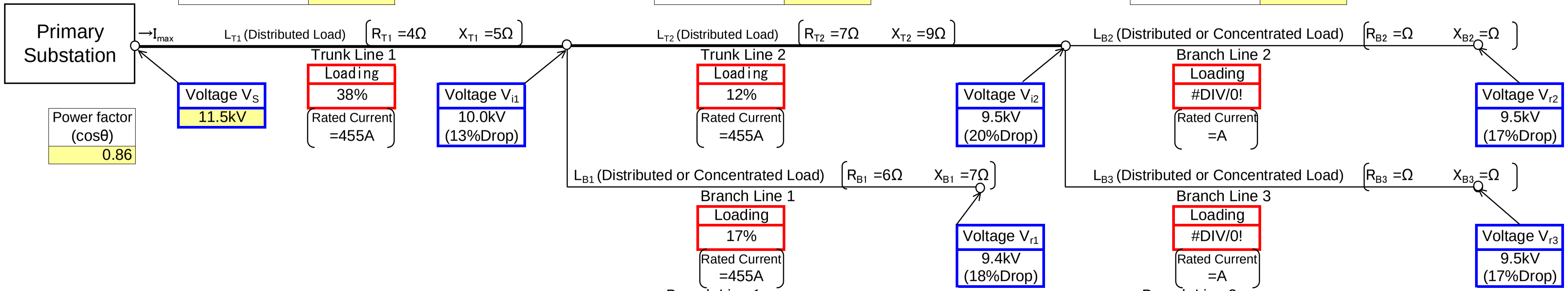
Load L_{T2}	53A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	24km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}
171A

Power factor (cosθ)
0.86



<Branch Line 1>

Load L_{B1}	77A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	2765kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P
Feeder Name	APAM

: Input data in colored cells

Type-3

Maximum Current I_{max}
180A

Power factor (cosθ)
0.86

<Trank Line 1>

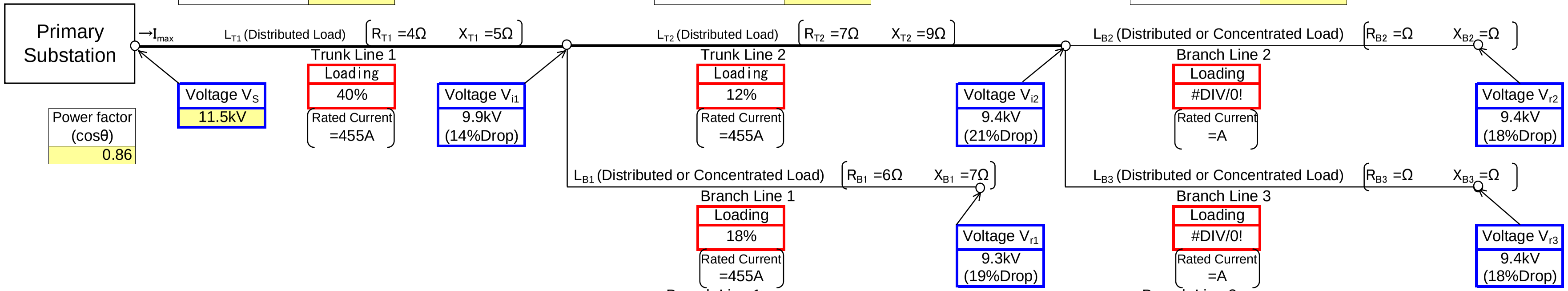
Load L_{T1}	43A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1465kVA	

<Trank Line 2>

Load L_{T2}	56A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	24km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	81A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	2765kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

- V_s : Supply Voltage
- V_{i1} : Interim Voltage
- V_{i2} : Interim Voltage
- V_{r1} : Received Voltage
- V_{r2} : Received Voltage
- V_{r3} : Received Voltage
- I_{max} : Maximum Current
- L_{T1} : Load (Trunk line 1)
- L_{T2} : Load (Trunk line 2)
- L_{B1} : Load (Branch Line 1)
- L_{B2} : Load (Branch Line 2)
- L_{B3} : Load (Branch Line 3)
- $R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
- $X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
- $f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
- $CAP_{T1}, CAP_{T2}, CAP_{B1}$, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
- cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P
Feeder Name	APAM

: Input data in colored cells

Type-3

Maximum Current I_{max}: 189A

Power factor (cosθ): 0.86

<Trank Line 1>

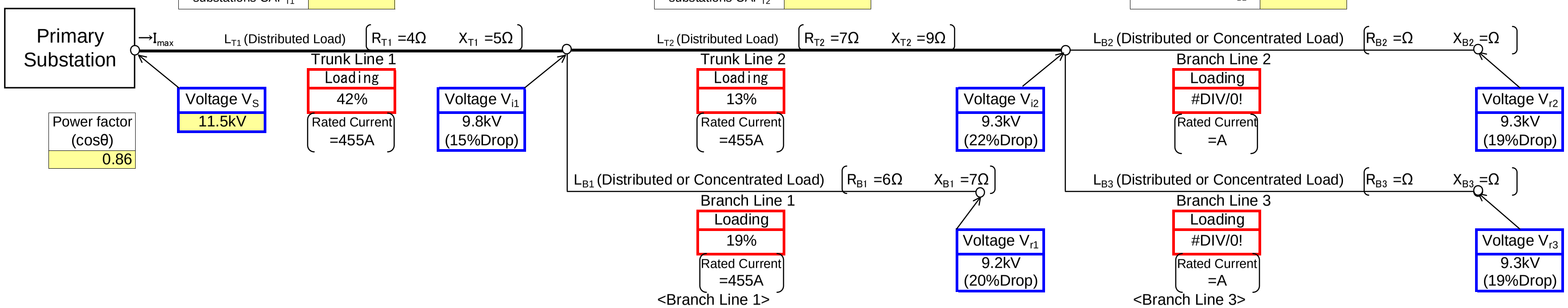
Load L_{T1}	45A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1465kVA	

<Trank Line 2>

Load L_{T2}	59A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	24km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	85A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	2765kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P
Feeder Name	APAM

: Input data in colored cells

Type-3

Primary Substation

Maximum Current I_{max}
199A

Power factor (cosθ)
0.86

→I_{max}

Voltage V_s
11.5kV

<Trank Line 1>

Load L_{T1}	48A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1465kVA	

L_{T1} (Distributed Load) (R_{T1} =4Ω X_{T1} =5Ω)

Trunk Line 1: Loading 44%, Rated Current =455A

Voltage V_{i1}
9.7kV (15%Drop)

<Trank Line 2>

Load L_{T2}	62A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	24km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

L_{T2} (Distributed Load) (R_{T2} =7Ω X_{T2} =9Ω)

Trunk Line 2: Loading 14%, Rated Current =455A

Voltage V_{i2}
9.2kV (24%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2: Loading #DIV/0!, Rated Current =A

Voltage V_{r2}
9.2kV (20%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =6Ω X_{B1} =7Ω)

Branch Line 1: Loading 20%, Rated Current =455A

Voltage V_{r1}
9.0kV (21%Drop)

<Branch Line 1>

Load L_{B1}	90A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	2765kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!, Rated Current =A

Voltage V_{r3}
9.2kV (20%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P
Feeder Name	APAM

(yellow) : Input data in colored cells

Type-3

Maximum Current I_{max}	209A
Power factor (cosθ)	0.86

Primary Substation — Voltage V_S: 11.5kV

<Trank Line 1>

Load L_{T1}	50A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1465kVA	

L_{T1} (Distributed Load) (R_{T1} =4Ω X_{T1} =5Ω)
Trunk Line 1: Loading 46%, Rated Current =455A
Voltage V_{i1}: 9.6kV (16%Drop)

<Trank Line 2>

Load L_{T2}	65A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	24km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

L_{T2} (Distributed Load) (R_{T2} =7Ω X_{T2} =9Ω)
Trunk Line 2: Loading 14%, Rated Current =455A
Voltage V_{i2}: 9.1kV (25%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)
Branch Line 2: Loading #DIV/0!, Rated Current =A
Voltage V_{r2}: 9.1kV (21%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =6Ω X_{B1} =7Ω)
Branch Line 1: Loading 21%, Rated Current =455A
Voltage V_{r1}: 8.9kV (22%Drop)

<Branch Line 1>

Load L_{B1}	94A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	2765kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)
Branch Line 3: Loading #DIV/0!, Rated Current =A
Voltage V_{r3}: 9.1kV (21%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	ODA
Feeder Name	SIKUMA (ACHIASI

: Input data in colored cells

Type-2

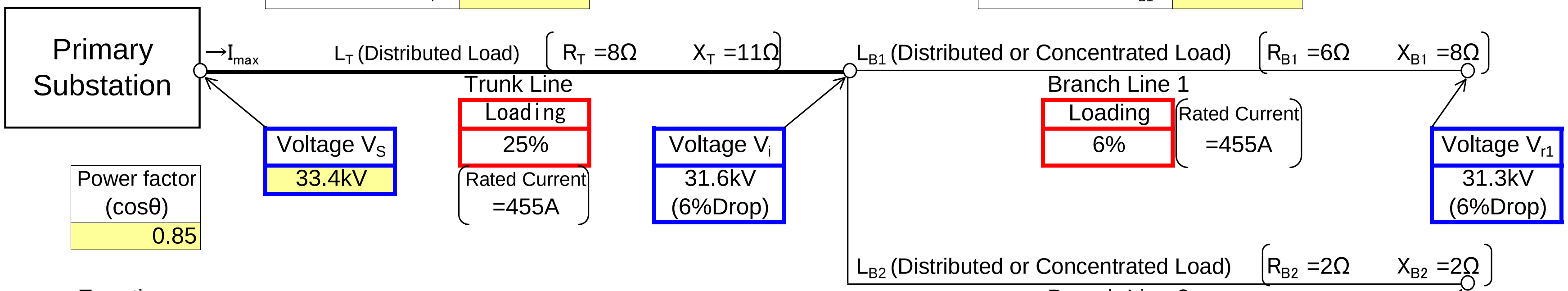
<Trank Line>

Load L_T	68A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	31km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	1700kVA	

<Branch Line 1>

Load L_{B1}	28A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	700kVA	

Maximum Current I_{max}	116A
Power factor (cosθ)	0.85



<Branch Line 2>

Load L_{B2}	20A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	7km	
Total Transformer Capacity of secondary substations CAP_{B2}	500kVA	

=====Equation=====

$V_i = V_s - 1.732 \cdot (R_T \cos\theta + X_T \sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T + CAP_{B1} + CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage I_{max} : Maximum Current R_T, R_{B1}, R_{B2} : Resistance

V_i : Interim Voltage L_T : Load (Trunk line) X_T, X_{B1}, X_{B2} : Reactance

V_{r1} : Received Voltage L_{B1} : Load (Branch Line 1)   cosθ : Power Factor

V_{r2} : Received Voltage L_{B2} : Load (Branch Line 2) f_T, f_{B1}, f_{B2} : Dispersal Load Factor CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	ODA
Feeder Name	SIKUMA (ACHIASI

: Input data in colored cells

Type-2

Maximum Current I_{max}
119A

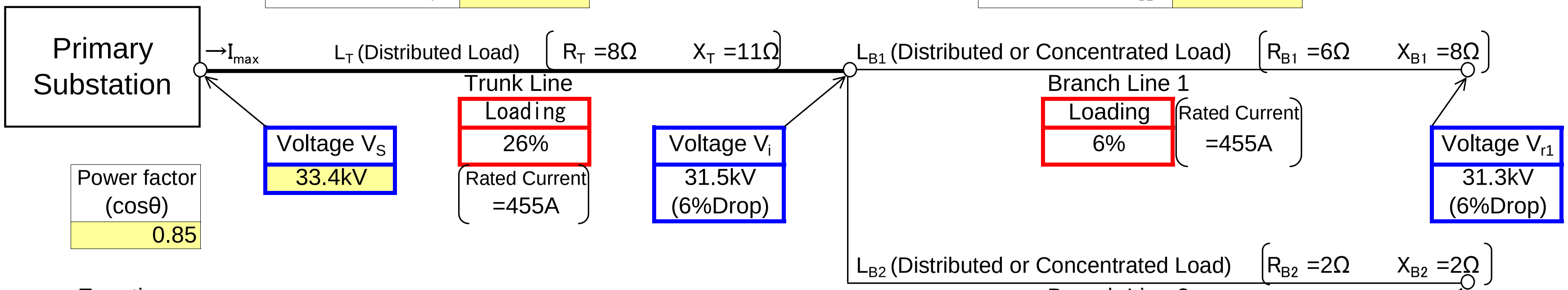
Power factor (cosθ)
0.85

<Trank Line>

Load L_T	70A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	31km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	1700kVA	

<Branch Line 1>

Load L_{B1}	29A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	700kVA	



<Branch Line 2>

Load L_{B2}	21A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	7km	
Total Transformer Capacity of secondary substations CAP_{B2}	500kVA	

=====Equation=====

$V_i = V_s - 1.732 \cdot (R_T\cos\theta + X_T\sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T + CAP_{B1} + CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_T, R_{B1}, R_{B2}	: Resistance
V_i	: Interim Voltage	L_T	: Load (Trunk line)	X_T, X_{B1}, X_{B2}	: Reactance
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	cosθ	: Power Factor
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	f_T, f_{B1}, f_{B2}	: Dispersal Load Factor

CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	ODA
Feeder Name	SIKUMA (ACHIASI

: Input data in colored cells

Type-2

Maximum Current I_{max}
123A

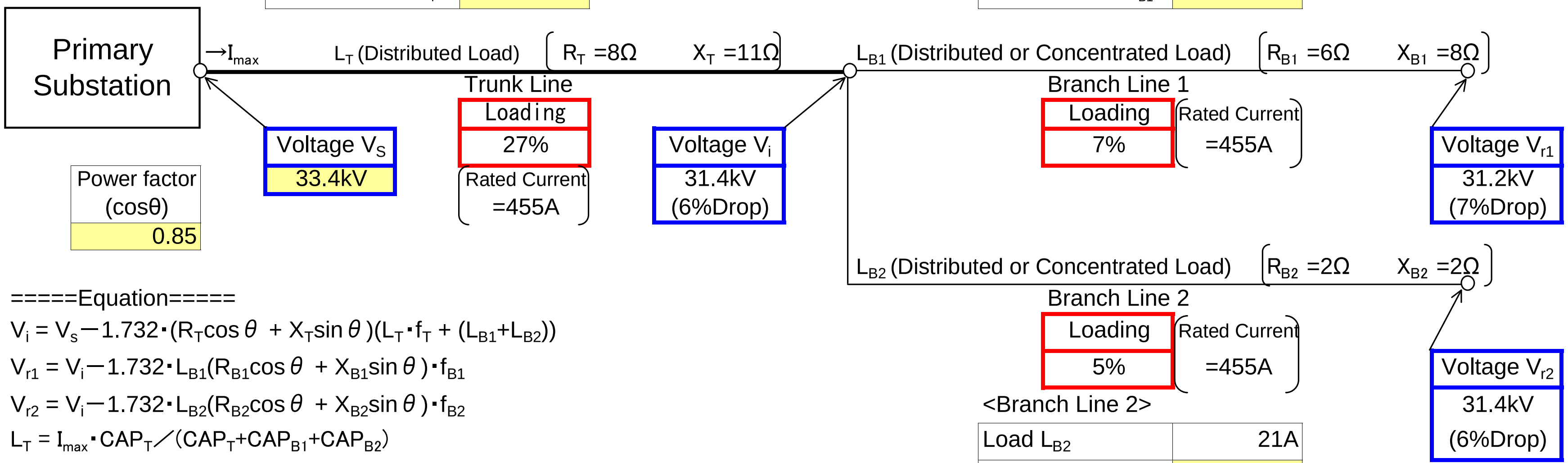
Power factor (cosθ)
0.85

<Trank Line>

Load L_T	72A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	31km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	1700kVA	

<Branch Line 1>

Load L_{B1}	30A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	700kVA	



<Branch Line 2>

Load L_{B2}	21A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	7km	
Total Transformer Capacity of secondary substations CAP_{B2}	500kVA	

=====Equation=====

$V_i = V_s - 1.732 \cdot (R_T \cos\theta + X_T \sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T + CAP_{B1} + CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_T, R_{B1}, R_{B2} : Resistance
V_i : Interim Voltage	L_T : Load (Trunk line)	X_T, X_{B1}, X_{B2} : Reactance
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	cosθ : Power Factor
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	f_T, f_{B1}, f_{B2} : Dispersal Load Factor

CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	ODA
Feeder Name	SIKUMA (ACHIASI

: Input data in colored cells

Type-2

Maximum Current I_{max}
127A

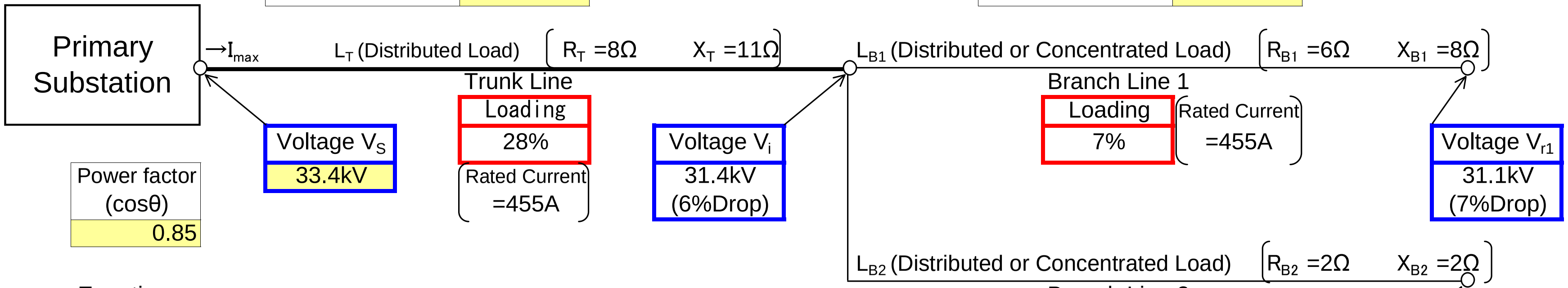
Power factor (cosθ)
0.85

<Trank Line>

Load L_T	74A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	31km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	1700kVA	

<Branch Line 1>

Load L_{B1}	31A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	700kVA	



<Branch Line 2>

Load L_{B2}	22A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	7km	
Total Transformer Capacity of secondary substations CAP_{B2}	500kVA	

=====Equation=====

$V_i = V_s - 1.732 \cdot (R_T \cos\theta + X_T \sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage; I_{max} : Maximum Current; R_T, R_{B1}, R_{B2} : Resistance
V_i : Interim Voltage; L_T : Load (Trunk line); X_T, X_{B1}, X_{B2} : Reactance
V_{r1} : Received Voltage; L_{B1} : Load (Branch Line 1); cosθ : Power Factor
V_{r2} : Received Voltage; L_{B2} : Load (Branch Line 2); f_T, f_{B1}, f_{B2} : Dispersal Load Factor; CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	ODA
Feeder Name	SIKUMA (ACHIASI

: Input data in colored cells

Type-2

Maximum Current I_{max}
130A

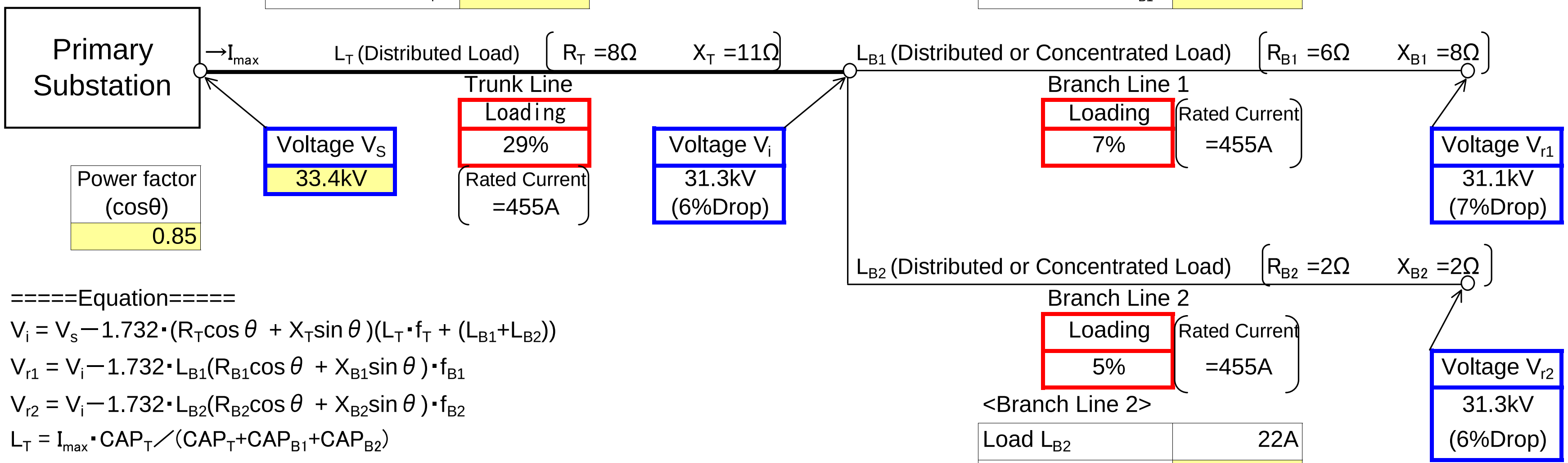
Power factor (cosθ)
0.85

<Trank Line>

Load L_T	76A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	31km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	1700kVA	

<Branch Line 1>

Load L_{B1}	31A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	700kVA	



<Branch Line 2>

Load L_{B2}	22A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	7km	
Total Transformer Capacity of secondary substations CAP_{B2}	500kVA	

=====Equation=====

$V_i = V_s - 1.732 \cdot (R_T \cos\theta + X_T \sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T + CAP_{B1} + CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage
V_i : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
I_{max} : Maximum Current
L_T : Load (Trunk line)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
R_T, R_{B1}, R_{B2} : Resistance
X_T, X_{B1}, X_{B2} : Reactance
cosθ : Power Factor
f_T, f_{B1}, f_{B2} : Dispersal Load Factor
CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	ODA
Feeder Name	SIKUMA (ACHIASI

: Input data in colored cells

Type-2

Maximum Current I_{max}	134A

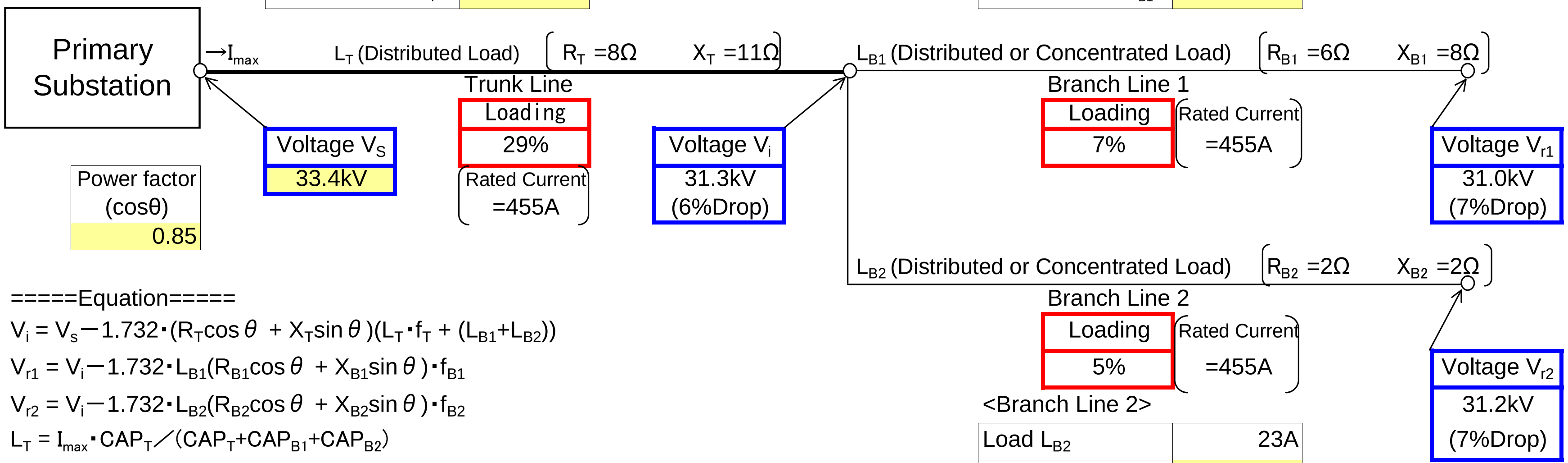
Power factor (cosθ)	0.85

<Trank Line>

Load L_T	79A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	31km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	1700kVA	

<Branch Line 1>

Load L_{B1}	32A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	700kVA	



<Branch Line 2>

Load L_{B2}	23A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	7km	
Total Transformer Capacity of secondary substations CAP_{B2}	500kVA	

=====Equation=====

$V_i = V_s - 1.732 \cdot (R_T \cos\theta + X_T \sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T + CAP_{B1} + CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage
V_i : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
I_{max} : Maximum Current
L_T : Load (Trunk line)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
R_T, R_{B1}, R_{B2} : Resistance
X_T, X_{B1}, X_{B2} : Reactance
cosθ : Power Factor
f_T, f_{B1}, f_{B2} : Dispersal Load Factor
CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	ODA
Feeder Name	SIKUMA (ACHIASI

: Input data in colored cells

Type-2

<Trank Line>

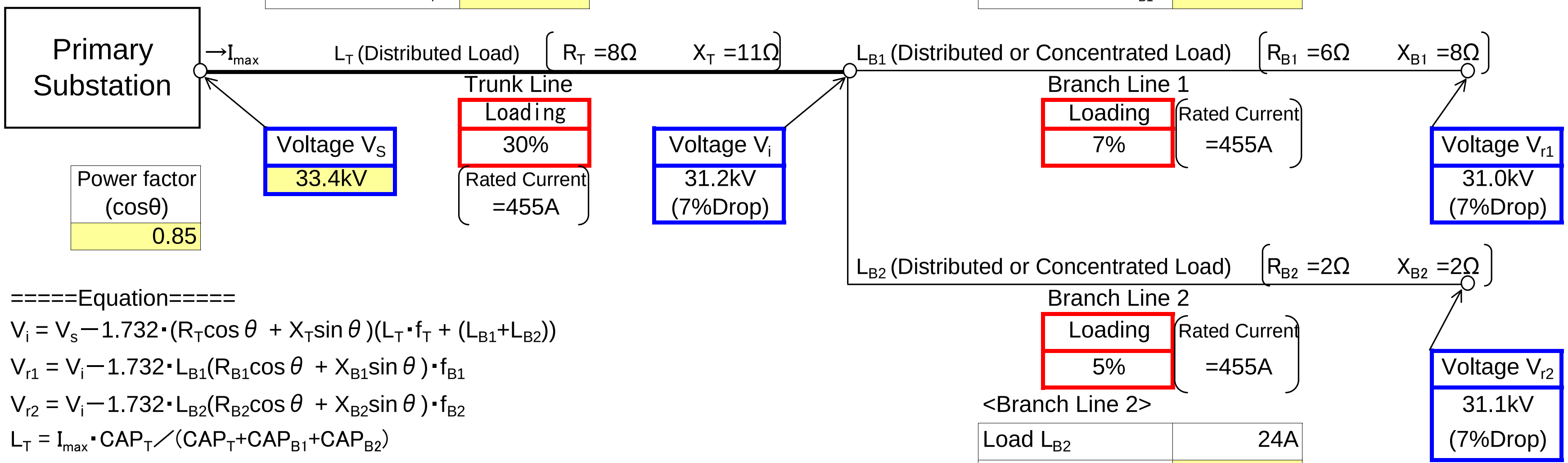
Load L_T	81A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	31km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	1700kVA	

Maximum Current I_{max}	138A

Power factor (cosθ)	0.85

<Branch Line 1>

Load L_{B1}	33A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	700kVA	



<Branch Line 2>

Load L_{B2}	24A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	7km	
Total Transformer Capacity of secondary substations CAP_{B2}	500kVA	

=====Equation=====

$V_i = V_s - 1.732 \cdot (R_T\cos\theta + X_T\sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T + CAP_{B1} + CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_T, R_{B1}, R_{B2} : Resistance
V_i : Interim Voltage	L_T : Load (Trunk line)	X_T, X_{B1}, X_{B2} : Reactance
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	cosθ : Power Factor
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	f_T, f_{B1}, f_{B2} : Dispersal Load Factor

CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	ODA
Feeder Name	SIKUMA (ACHIASI

: Input data in colored cells

Type-2

Maximum Current I_{max}
142A

Power factor (cosθ)
0.85

<Trank Line>

Load L_T	83A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	31km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	1700kVA	

<Branch Line 1>

Load L_{B1}	34A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	700kVA	

Primary Substation

$\rightarrow I_{max}$ L_T (Distributed Load) (R_T =8Ω X_T =11Ω)

Trunk Line: Loading 31% (Rated Current =455A)

Voltage V_S: 33.4kV

Voltage V_i: 31.1kV (7%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =6Ω X_{B1} =8Ω)

Branch Line 1: Loading 8% (Rated Current =455A)

Voltage V_{r1}: 30.9kV (8%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =2Ω X_{B2} =2Ω)

Branch Line 2: Loading 5% (Rated Current =455A)

Voltage V_{r2}: 31.1kV (7%Drop)

<Branch Line 2>

Load L_{B2}	24A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	7km	
Total Transformer Capacity of secondary substations CAP_{B2}	500kVA	

=====Equation=====

$V_i = V_s - 1.732 \cdot (R_T \cos\theta + X_T \sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage I_{max} : Maximum Current R_T, R_{B1}, R_{B2} : Resistance

V_i : Interim Voltage L_T : Load (Trunk line) X_T, X_{B1}, X_{B2} : Reactance

V_{r1} : Received Voltage L_{B1} : Load (Branch Line 1) cosθ : Power Factor

V_{r2} : Received Voltage L_{B2} : Load (Branch Line 2) f_T, f_{B1}, f_{B2} : Dispersal Load Factor CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	ODA
Feeder Name	SIKUMA (ACHIASI

: Input data in colored cells

Type-2

Maximum Current I_{max}
146A

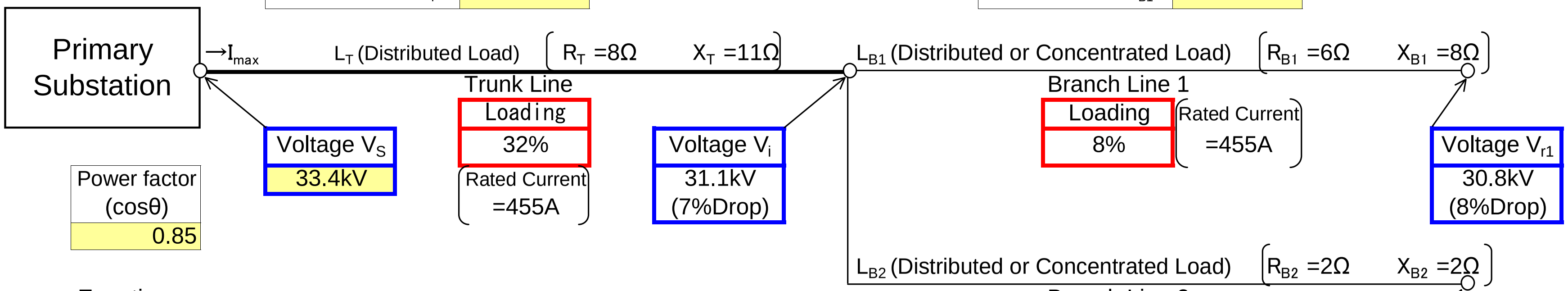
Power factor (cosθ)
0.85

<Trank Line>

Load L_T	86A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	31km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	1700kVA	

<Branch Line 1>

Load L_{B1}	35A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	700kVA	



<Branch Line 2>

Load L_{B2}	25A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	7km	
Total Transformer Capacity of secondary substations CAP_{B2}	500kVA	

=====Equation=====

$V_i = V_s - 1.732 \cdot (R_T \cos\theta + X_T \sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_T, R_{B1}, R_{B2} : Resistance	
V_i : Interim Voltage	L_T : Load (Trunk line)	X_T, X_{B1}, X_{B2} : Reactance	
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	cosθ : Power Factor	
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	f_T, f_{B1}, f_{B2} : Dispersal Load Factor	CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	ODA
Feeder Name	SIKUMA (ACHIASI

: Input data in colored cells

Type-2

Maximum Current I_{max}
150A

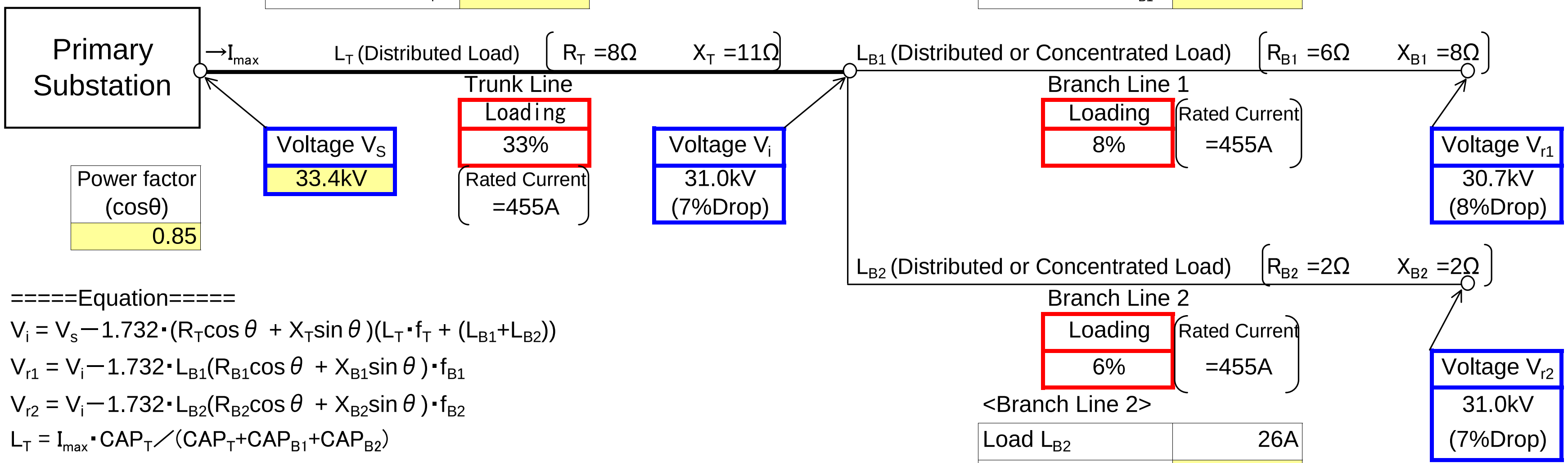
Power factor (cosθ)
0.85

<Trank Line>

Load L_T	88A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	31km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	1700kVA	

<Branch Line 1>

Load L_{B1}	36A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	700kVA	



<Branch Line 2>

Load L_{B2}	26A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	7km	
Total Transformer Capacity of secondary substations CAP_{B2}	500kVA	

=====Equation=====

$V_i = V_s - 1.732 \cdot (R_T \cos\theta + X_T \sin\theta)(L_T \cdot f_T + (L_{B1} + L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T + CAP_{B1} + CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_T, R_{B1}, R_{B2}	: Resistance
V_i	: Interim Voltage	L_T	: Load (Trunk line)	X_T, X_{B1}, X_{B2}	: Reactance
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	cosθ	: Power Factor
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	f_T, f_{B1}, f_{B2}	: Dispersal Load Factor

CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	ODA
Feeder Name	SIKUMA (ACHIASI

: Input data in colored cells

Type-2

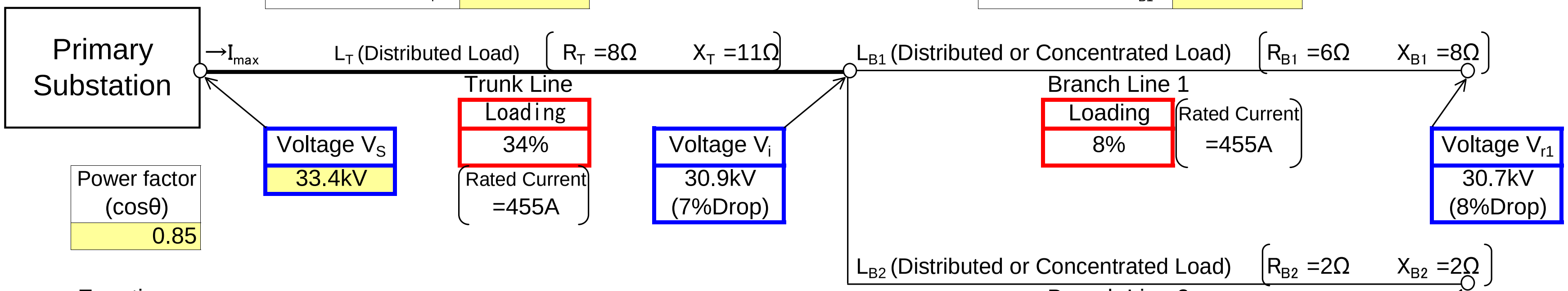
Maximum Current I_{max}
155A

<Trank Line>

Load L_T	91A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	31km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	1700kVA	

<Branch Line 1>

Load L_{B1}	37A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	700kVA	



Power factor (cosθ)
0.85

<Branch Line 2>

Load L_{B2}	27A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	7km	
Total Transformer Capacity of secondary substations CAP_{B2}	500kVA	

=====Equation=====

$V_i = V_s - 1.732 \cdot (R_T\cos\theta + X_T\sin\theta)(L_T \cdot f_T + (L_{B1}+L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T+CAP_{B1}+CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T+CAP_{B1}+CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

V_s : Supply Voltage I_{max} : Maximum Current R_T, R_{B1}, R_{B2} : Resistance

V_i : Interim Voltage L_T : Load (Trunk line) X_T, X_{B1}, X_{B2} : Reactance

V_{r1} : Received Voltage L_{B1} : Load (Branch Line 1) cosθ : Power Factor

V_{r2} : Received Voltage L_{B2} : Load (Branch Line 2) f_T, f_{B1}, f_{B2} : Dispersal Load Factor CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	ODA
Feeder Name	SIKUMA (ACHIASI

: Input data in colored cells

Type-2

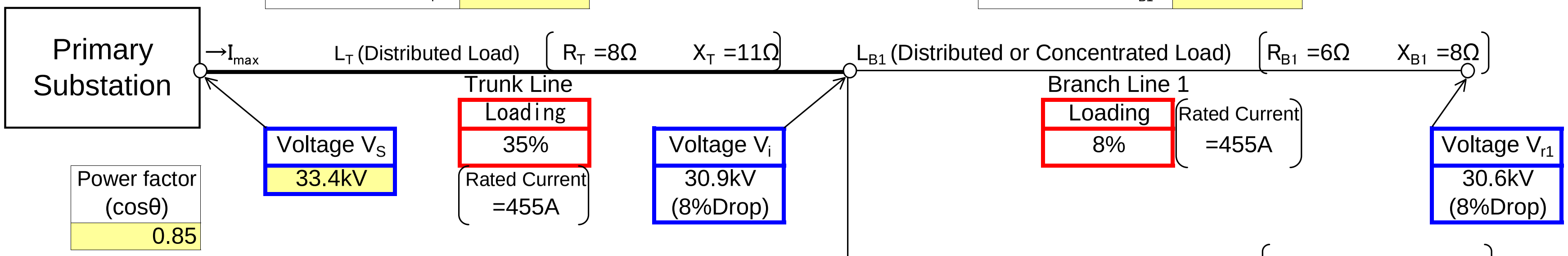
Maximum Current I_{max}
159A

<Trank Line>

Load L_T	93A	
Line Type	AAC120mm2	No.7
Line Legth Len_T	31km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_T	1700kVA	

<Branch Line 1>

Load L_{B1}	38A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	700kVA	



Power factor (cosθ)
0.85

L_{B2} (Distributed or Concentrated Load) (R_{B2} =2Ω X_{B2} =2Ω)

Branch Line 2

Loading	Rated Current
6%	=455A

Voltage V_{r2}
30.8kV (8%Drop)

=====Equation=====

$V_i = V_s - 1.732 \cdot (R_T \cos\theta + X_T \sin\theta)(L_T \cdot f_T + (L_{B1} + L_{B2}))$

$V_{r1} = V_i - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_i - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$L_T = I_{max} \cdot CAP_T / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_T + CAP_{B1} + CAP_{B2})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_T + CAP_{B1} + CAP_{B2})$

$I_{max} = L_T + L_{B1} + L_{B2}$

<Branch Line 2>

Load L_{B2}	27A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	7km	
Total Transformer Capacity of secondary substations CAP_{B2}	500kVA	

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_T, R_{B1}, R_{B2}	: Resistance
V_i	: Interim Voltage	L_T	: Load (Trunk line)	X_T, X_{B1}, X_{B2}	: Reactance
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	cosθ	: Power Factor
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	f_T, f_{B1}, f_{B2}	: Dispersal Load Factor

CAP_T, CAP_{B1}, CAP_{B2} : Total Transformer Capacity of secondary substations

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 2

: Input data in colored cells

Type-3

Maximum Current I_{max}	280A
Power factor (cosθ)	0.86

Primary Substation →I_{max}

Voltage V_s: 11.5kV

<Trank Line 1>

Load L_{T1}	76A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	17km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2950kVA	

L_{T1} (Distributed Load) (R_{T1} =2Ω X_{T1} =2Ω)

Trunk Line 1: Loading 84%, Rated Current =335A

Voltage V_{i1}: 10.2kV (12%Drop)

<Trank Line 2>

Load L_{T2}	54A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	21km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2075kVA	

L_{T2} (Distributed Load) (R_{T2} =3Ω X_{T2} =3Ω)

Trunk Line 2: Loading 16%, Rated Current =335A

Voltage V_{i2}: 10.0kV (15%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2: Loading #DIV/0!, Rated Current =A

Voltage V_{r2}: 10.0kV (13%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =5Ω X_{B1} =2Ω)

Branch Line 1: Loading 68%, Rated Current =220A

Voltage V_{r1}: 9.5kV (17%Drop)

<Branch Line 1>

Load L_{B1}	150A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	5795kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!, Rated Current =A

Voltage V_{r3}: 10.0kV (13%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	cape coast B.S.P.
Feeder Name	ELMINA

: Input data in colored cells

Type-3

Maximum Current I_{max}
320A

Power factor (cosθ)
0.86

<Trank Line 1>

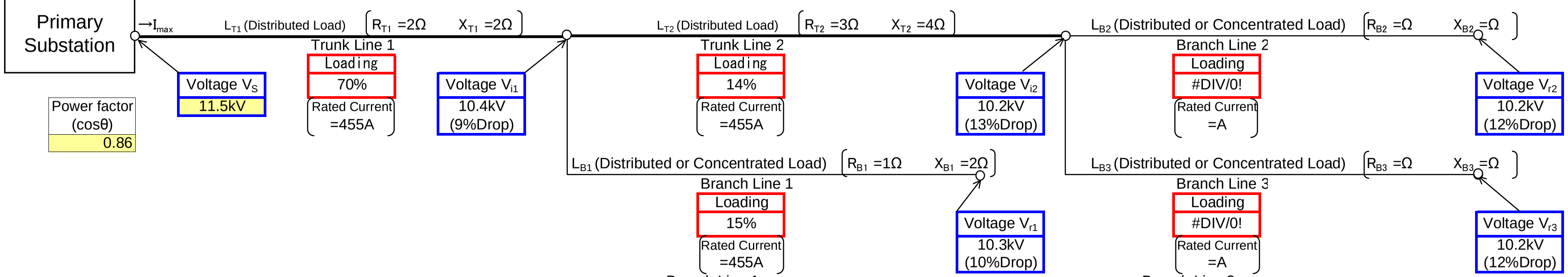
Load L_{T1}	188A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	7525kVA	

<Trank Line 2>

Load L_{T2}	63A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2500kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	69A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	4km	
Total Transformer Capacity of secondary substations CAP_{B1}	2750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	cape coast B.S.P.
Feeder Name	ELMINA

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	200A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	7525kVA	

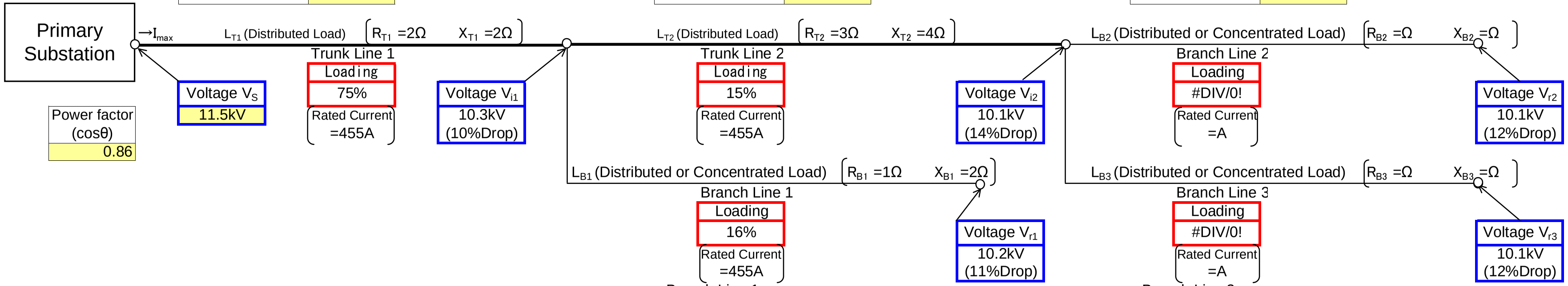
<Trank Line 2>

Load L_{T2}	67A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2500kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}	340A
Power factor (cosθ)	0.86



<Branch Line 1>

Load L_{B1}	73A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	4km	
Total Transformer Capacity of secondary substations CAP_{B1}	2750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	cape coast B.S.P.
Feeder Name	ELMINA

: Input data in colored cells

Type-3

Maximum Current I_{max}
361A

Power factor (cosθ)
0.86

<Trank Line 1>

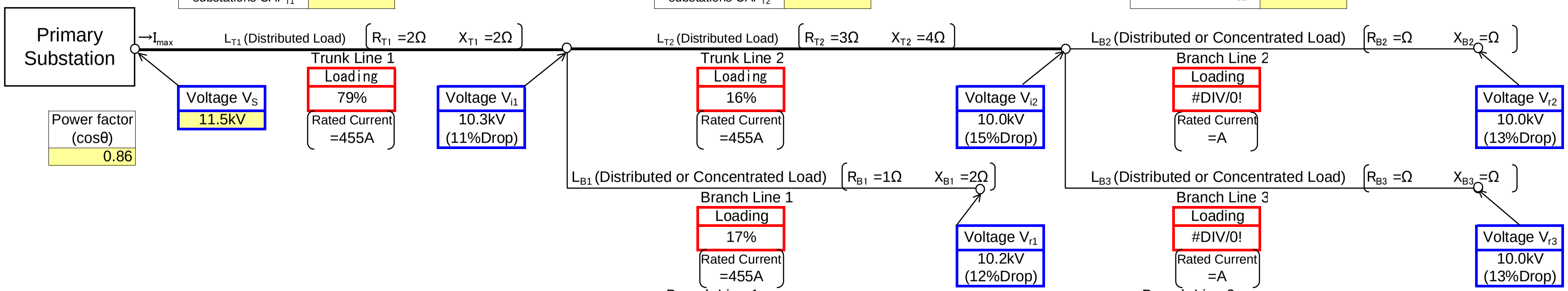
Load L_{T1}	213A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	7525kVA	

<Trank Line 2>

Load L_{T2}	71A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2500kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	78A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	4km	
Total Transformer Capacity of secondary substations CAP_{B1}	2750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage
V_{i1} : Interim Voltage
V_{i2} : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
V_{r3} : Received Voltage

I_{max} : Maximum Current
L_{T1} : Load (Trunk line 1)
L_{T2} : Load (Trunk line 2)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
L_{B3} : Load (Branch Line 3)

$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
$CAP_{T1}, CAP_{T2}, CAP_{B1}$, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	ELMINA

: Input data in colored cells

Type-3

Maximum Current I_{max}
384A

<Trank Line 1>

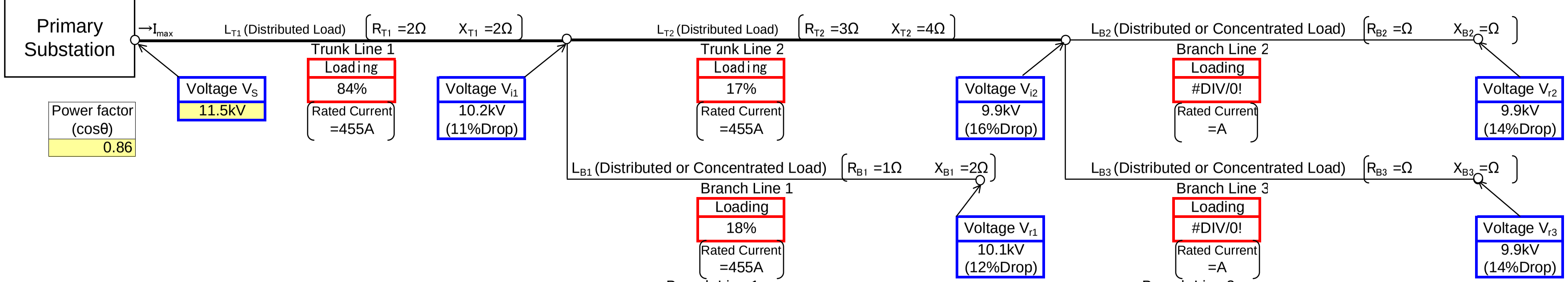
Load L_{T1}	226A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	7525kVA	

<Trank Line 2>

Load L_{T2}	75A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2500kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	83A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	4km	
Total Transformer Capacity of secondary substations CAP_{B1}	2750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	ELMINA

: Input data in colored cells

Type-3

Maximum Current I_{max}
408A

Power factor (cosθ)
0.86

<Trank Line 1>

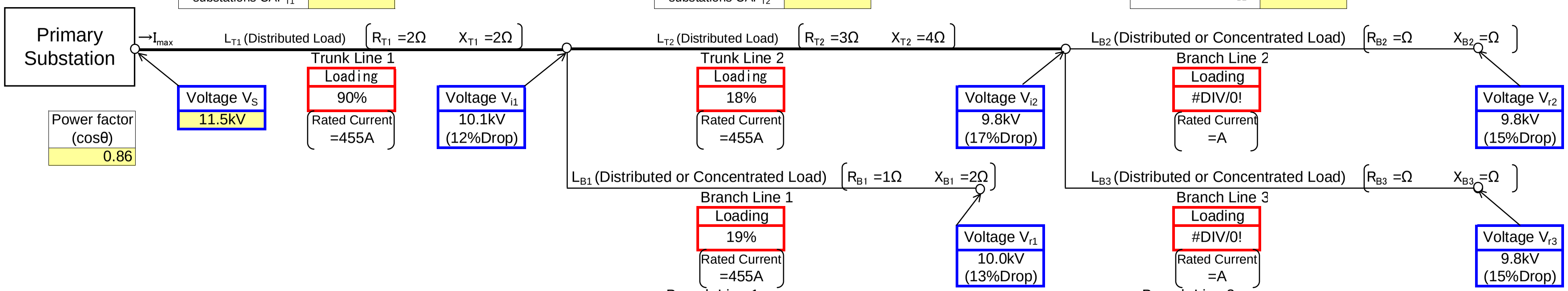
Load L_{T1}	240A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	7525kVA	

<Trank Line 2>

Load L_{T2}	80A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2500kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	88A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	4km	
Total Transformer Capacity of secondary substations CAP_{B1}	2750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	ELMINA

: Input data in colored cells

Type-3

Maximum Current I_{max}
433A

Power factor (cosθ)
0.86

<Trank Line 1>

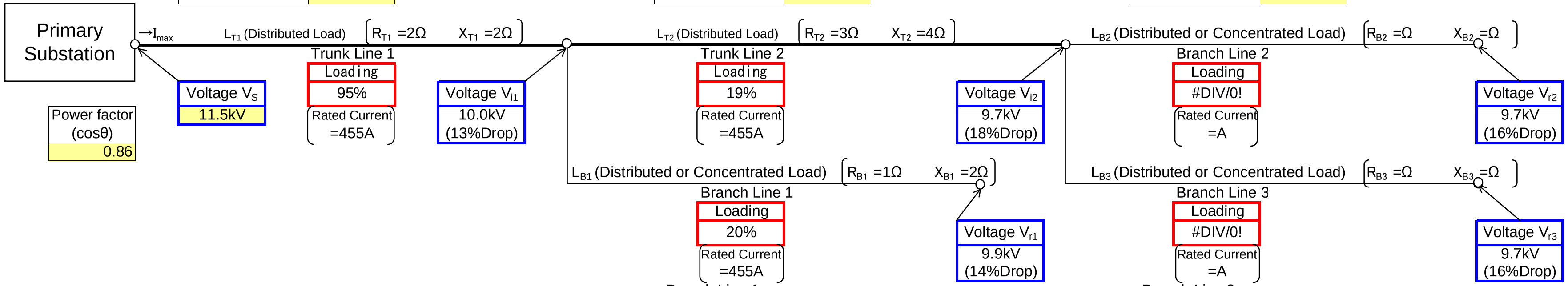
Load L_{T1}	255A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	7525kVA	

<Trank Line 2>

Load L_{T2}	85A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2500kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	93A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	4km	
Total Transformer Capacity of secondary substations CAP_{B1}	2750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	ELMINA

: Input data in colored cells

Type-3

Maximum Current I_{max}
460A

Power factor (cosθ)
0.86

<Trank Line 1>

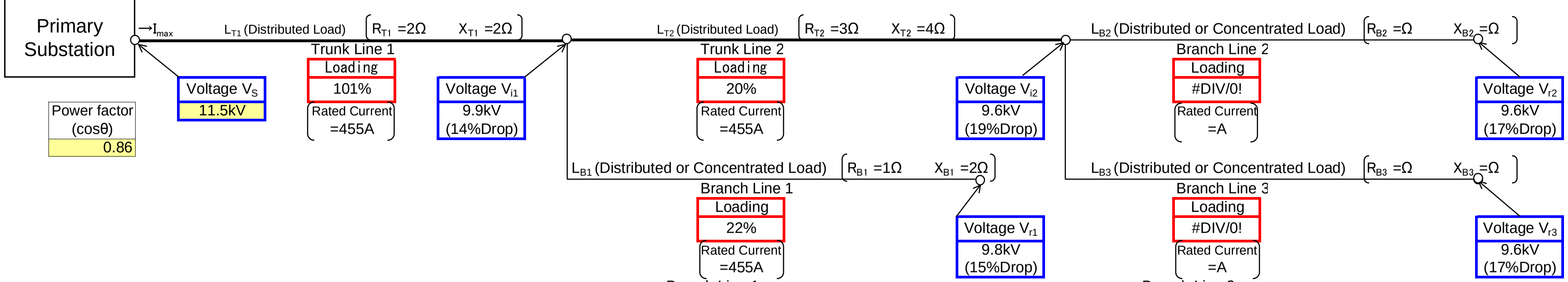
Load L_{T1}	271A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	7525kVA	

<Trank Line 2>

Load L_{T2}	90A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2500kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	99A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	4km	
Total Transformer Capacity of secondary substations CAP_{B1}	2750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	ELMINA

: Input data in colored cells

Type-3

<Trank Line 1>

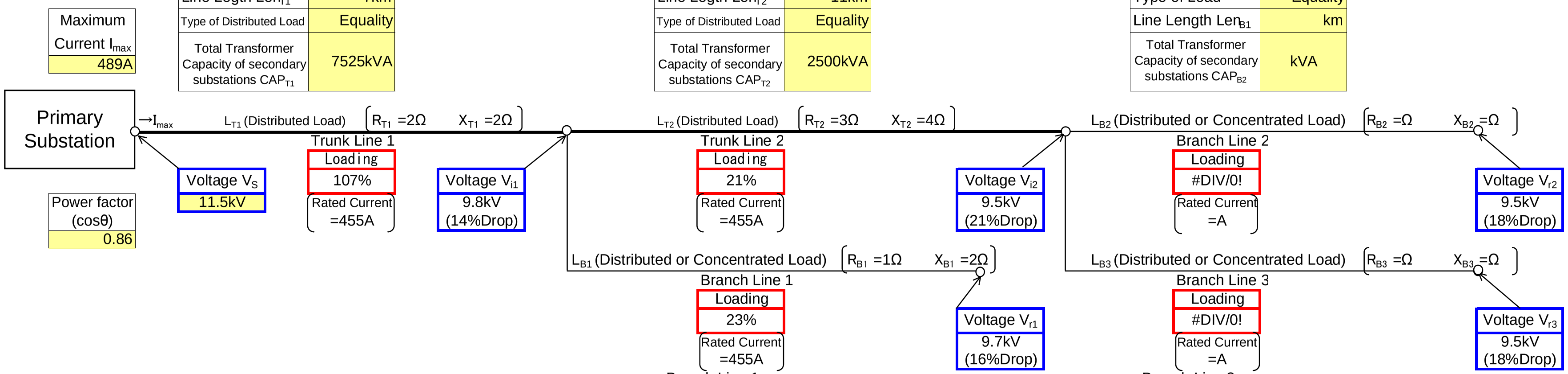
Load L_{T1}	288A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	7525kVA	

<Trank Line 2>

Load L_{T2}	96A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2500kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	105A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	4km	
Total Transformer Capacity of secondary substations CAP_{B1}	2750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage
V_{i1} : Interim Voltage
V_{i2} : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
V_{r3} : Received Voltage

I_{max} : Maximum Current
L_{T1} : Load (Trunk line 1)
L_{T2} : Load (Trunk line 2)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
L_{B3} : Load (Branch Line 3)

R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3} : Resistance
X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3} : Reactance
f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3} : Dispersal Load Factor
CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	ELMINA

: Input data in colored cells

Type-3

Maximum Current I_{max}
519A

Power factor (cosθ)
0.86

<Trank Line 1>

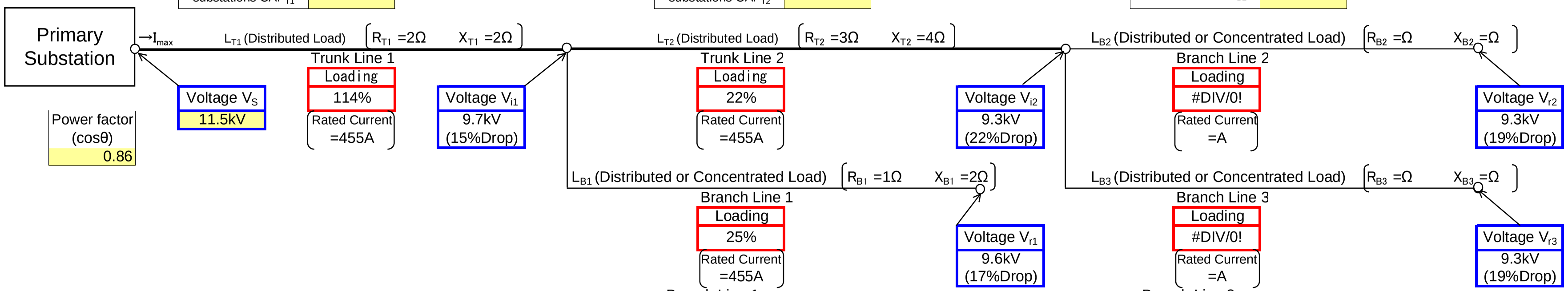
Load L_{T1}	306A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	7525kVA	

<Trank Line 2>

Load L_{T2}	102A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2500kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	112A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	4km	
Total Transformer Capacity of secondary substations CAP_{B1}	2750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	cape coast B.S.P.
Feeder Name	ELMINA

: Input data in colored cells

Type-3

Maximum Current I_{max}
552A

Power factor (cosθ)
0.86

<Trank Line 1>

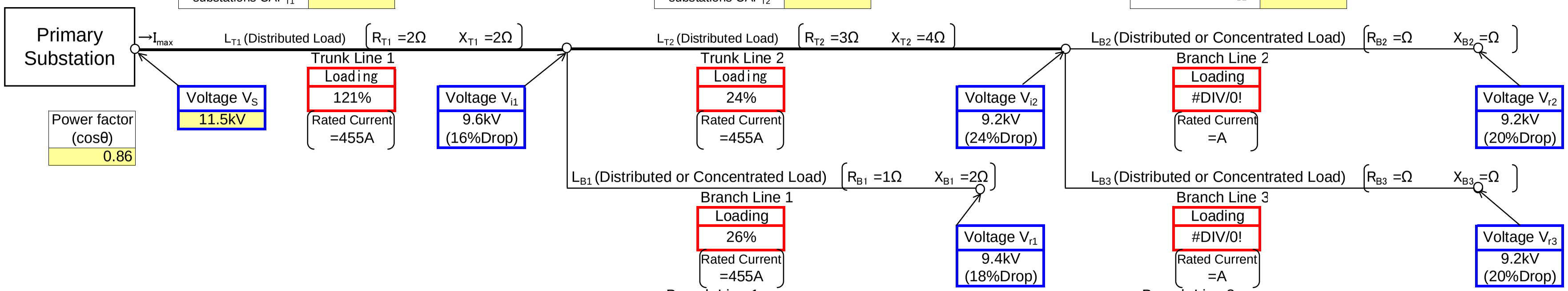
Load L_{T1}	325A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	7525kVA	

<Trank Line 2>

Load L_{T2}	108A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2500kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	119A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	4km	
Total Transformer Capacity of secondary substations CAP_{B1}	2750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	ELMINA

: Input data in colored cells

Type-3

Maximum Current I_{max}
586A

Power factor (cosθ)
0.86

<Trank Line 1>

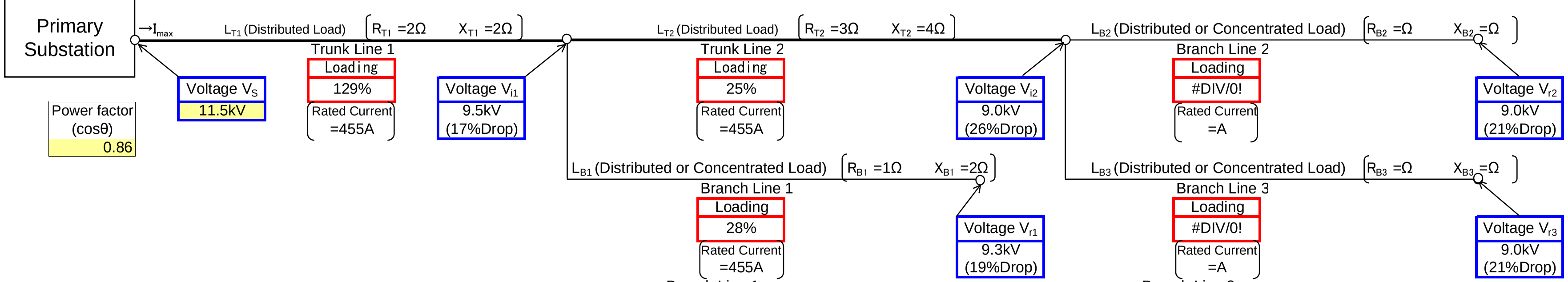
Load L_{T1}	345A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	7525kVA	

<Trank Line 2>

Load L_{T2}	115A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2500kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	126A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	4km	
Total Transformer Capacity of secondary substations CAP_{B1}	2750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	cape coast B.S.P.
Feeder Name	ELMINA

: Input data in colored cells

Type-3

Maximum Current I_{max}
623A

Power factor (cosθ)
0.86

<Trank Line 1>

Load L_{T1}	367A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	7525kVA	

<Trank Line 2>

Load L_{T2}	122A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2500kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Primary Substation →I_{max}

Voltage V_S: 11.5kV

L_{T1} (Distributed Load) (R_{T1} =2Ω X_{T1} =2Ω)

Trunk Line 1 — Loading: 137% — Rated Current =455A

Voltage V_{i1}: 9.4kV (18%Drop)

L_{T2} (Distributed Load) (R_{T2} =3Ω X_{T2} =4Ω)

Trunk Line 2 — Loading: 27% — Rated Current =455A

Voltage V_{i2}: 8.9kV (28%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2 — Loading: #DIV/0! — Rated Current =A

Voltage V_{r2}: 8.9kV (23%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =1Ω X_{B1} =2Ω)

Branch Line 1 — Loading: 29% — Rated Current =455A

Voltage V_{r1}: 9.2kV (20%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 — Loading: #DIV/0! — Rated Current =A

Voltage V_{r3}: 8.9kV (23%Drop)

<Branch Line 1>

Load L_{B1}	134A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	4km	
Total Transformer Capacity of secondary substations CAP_{B1}	2750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	FOSU

: Input data in colored cells

Type-3

Maximum Current I_{max}
112A

Power factor (cosθ)
0.86

Primary Substation → I_{max}

Voltage V_s 34.5kV

<Trank Line 1>

Load L_{T1}	23A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	28km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	3125kVA	

L_{T1} (Distributed Load) (R_{T1} =8Ω X_{T1} =10Ω)

Trunk Line 1: Loading 25%; Rated Current =455A

Voltage V_{i1} 32.5kV (6%Drop)

<Trank Line 2>

Load L_{T2}	22A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2950kVA	

L_{T2} (Distributed Load) (R_{T2} =3Ω X_{T2} =4Ω)

Trunk Line 2: Loading 12%; Rated Current =455A

Voltage V_{i2} 32.1kV (7%Drop)

<Branch Line 2>

Load L_{B2}	34A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	43km	
Total Transformer Capacity of secondary substations CAP_{B2}	4605kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =12Ω X_{B2} =15Ω)

Branch Line 2: Loading 7%; Rated Current =455A

Voltage V_{r2} 31.6kV (8%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =10Ω X_{B1} =14Ω)

Branch Line 1: Loading 7%; Rated Current =455A

Voltage V_{r1} 32.0kV (7%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!; Rated Current =A

Voltage V_{r3} 32.1kV (7%Drop)

<Branch Line 1>

Load L_{B1}	34A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B1}	4605kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	FOSU

: Input data in colored cells

Type-3

Maximum Current I_{max}
118A

Power factor (cosθ)
0.86

<Trank Line 1>

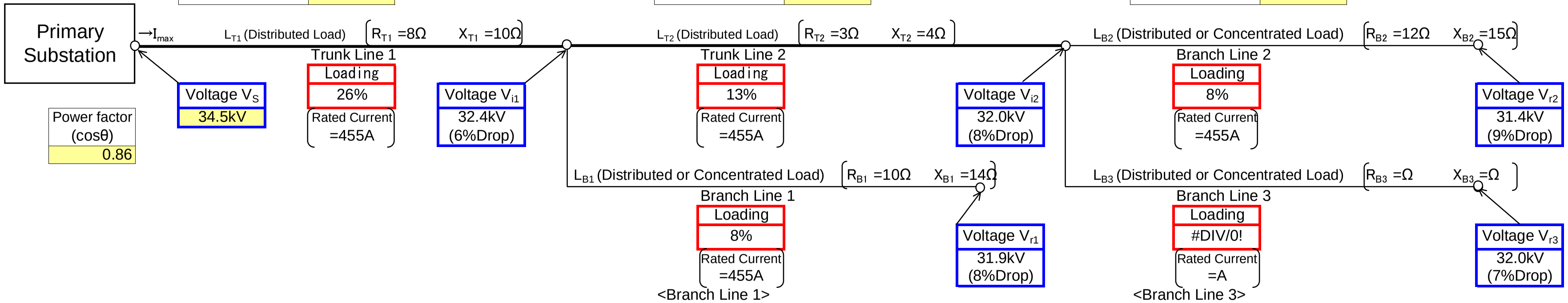
Load L_{T1}	24A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	28km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	3125kVA	

<Trank Line 2>

Load L_{T2}	23A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2950kVA	

<Branch Line 2>

Load L_{B2}	36A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	43km	
Total Transformer Capacity of secondary substations CAP_{B2}	4605kVA	



<Branch Line 1>

Load L_{B1}	36A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B1}	4605kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	FOSU

: Input data in colored cells

Type-3

Maximum Current I_{max}
123A

Power factor (cosθ)
0.86

<Trank Line 1>

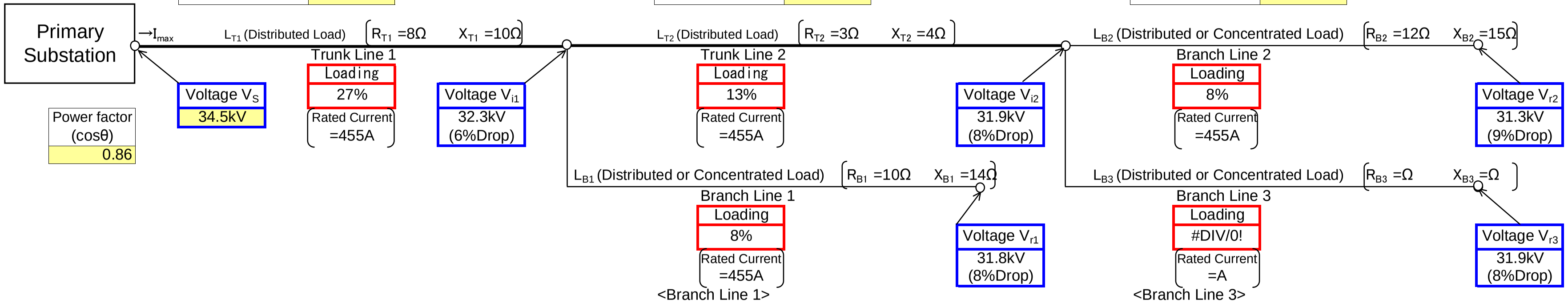
Load L_{T1}	25A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	28km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	3125kVA	

<Trank Line 2>

Load L_{T2}	24A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2950kVA	

<Branch Line 2>

Load L_{B2}	37A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	43km	
Total Transformer Capacity of secondary substations CAP_{B2}	4605kVA	



<Branch Line 1>

Load L_{B1}	37A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B1}	4605kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	FOSU

: Input data in colored cells

Type-3

Maximum Current I_{max}
130A

Power factor (cosθ)
0.86

<Trank Line 1>

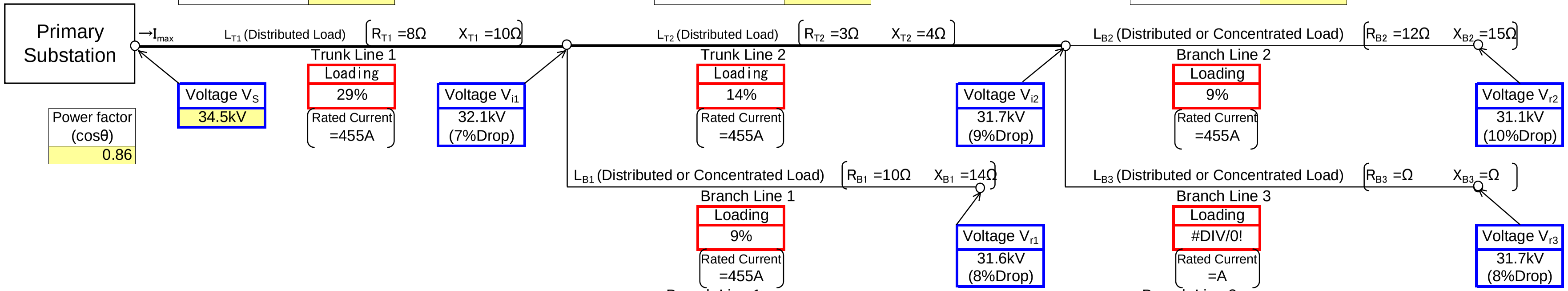
Load L_{T1}	27A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	28km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	3125kVA	

<Trank Line 2>

Load L_{T2}	25A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2950kVA	

<Branch Line 2>

Load L_{B2}	39A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	43km	
Total Transformer Capacity of secondary substations CAP_{B2}	4605kVA	



<Branch Line 1>

Load L_{B1}	39A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B1}	4605kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	FOSU

: Input data in colored cells

Type-3

Primary Substation

Maximum Current I_{max}
136A

Power factor (cosθ)
0.86

Voltage V_s
34.5kV

<Trank Line 1>

Load L_{T1}	28A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	28km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	3125kVA	

L_{T1} (Distributed Load) (R_{T1} =8Ω X_{T1} =10Ω)

Trunk Line 1: Loading 30%, Rated Current =455A

Voltage V_{i1}: 32.0kV (7%Drop)

<Trank Line 2>

Load L_{T2}	26A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2950kVA	

L_{T2} (Distributed Load) (R_{T2} =3Ω X_{T2} =4Ω)

Trunk Line 2: Loading 15%, Rated Current =455A

Voltage V_{i2}: 31.6kV (9%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =10Ω X_{B1} =14Ω)

Branch Line 1: Loading 9%, Rated Current =455A

Voltage V_{r1}: 31.5kV (9%Drop)

<Branch Line 1>

Load L_{B1}	41A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B1}	4605kVA	

<Branch Line 2>

Load L_{B2}	41A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	43km	
Total Transformer Capacity of secondary substations CAP_{B2}	4605kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =12Ω X_{B2} =15Ω)

Branch Line 2: Loading 9%, Rated Current =455A

Voltage V_{r2}: 31.0kV (10%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!, Rated Current =A

Voltage V_{r3}: 31.6kV (8%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	FOSU

: Input data in colored cells

Type-3

Maximum Current I_{max}
143A

Power factor (cosθ)
0.86

<Trank Line 1>

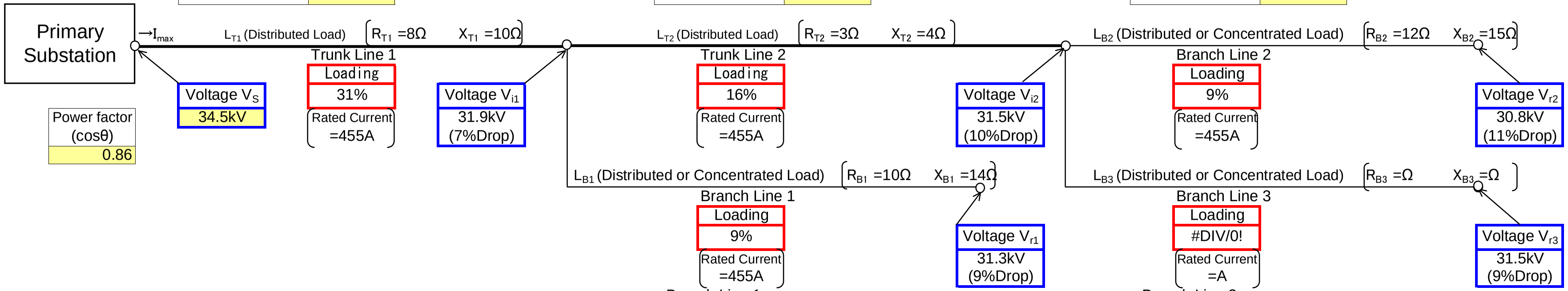
Load L_{T1}	29A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	28km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	3125kVA	

<Trank Line 2>

Load L_{T2}	28A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2950kVA	

<Branch Line 2>

Load L_{B2}	43A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	43km	
Total Transformer Capacity of secondary substations CAP_{B2}	4605kVA	



<Branch Line 1>

Load L_{B1}	43A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B1}	4605kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	FOSU

: Input data in colored cells

Type-3

Maximum Current I_{max}
150A

Power factor (cosθ)
0.86

<Trank Line 1>

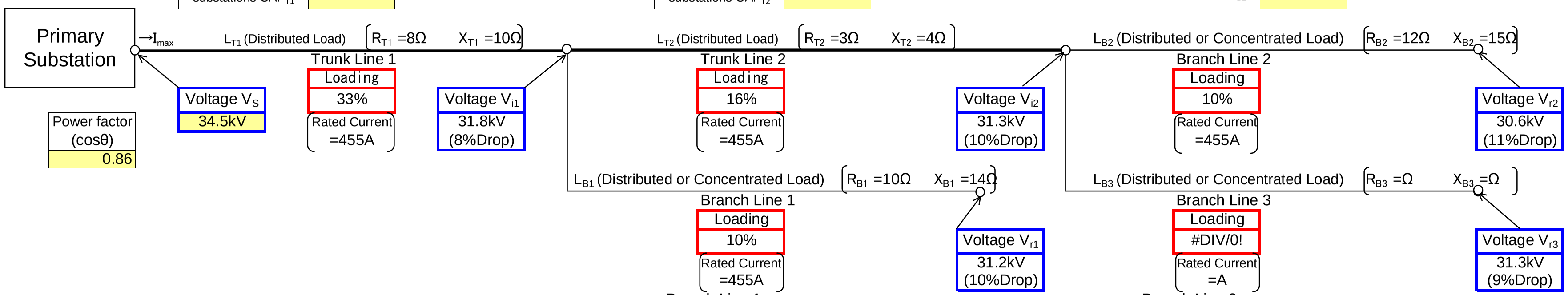
Load L_{T1}	31A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	28km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	3125kVA	

<Trank Line 2>

Load L_{T2}	29A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2950kVA	

<Branch Line 2>

Load L_{B2}	45A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	43km	
Total Transformer Capacity of secondary substations CAP_{B2}	4605kVA	



<Branch Line 1>

Load L_{B1}	45A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B1}	4605kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	FOSU

: Input data in colored cells

Type-3

Maximum Current I_{max}
157A

Power factor (cosθ)
0.86

Primary Substation →I_{max}

Voltage V_s: 34.5kV

<Trank Line 1>

Load L_{T1}	32A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	28km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	3125kVA	

L_{T1} (Distributed Load) (R_{T1} =8Ω X_{T1} =10Ω)

Trunk Line 1 — Loading 35% (Rated Current =455A)

Voltage V_{i1}: 31.7kV (8%Drop)

<Trank Line 2>

Load L_{T2}	30A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2950kVA	

L_{T2} (Distributed Load) (R_{T2} =3Ω X_{T2} =4Ω)

Trunk Line 2 — Loading 17% (Rated Current =455A)

Voltage V_{i2}: 31.2kV (11%Drop)

<Branch Line 2>

Load L_{B2}	47A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	43km	
Total Transformer Capacity of secondary substations CAP_{B2}	4605kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =12Ω X_{B2} =15Ω)

Branch Line 2 — Loading 10% (Rated Current =455A)

Voltage V_{r2}: 30.4kV (12%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =10Ω X_{B1} =14Ω)

Branch Line 1 — Loading 10% (Rated Current =455A)

Voltage V_{r1}: 31.0kV (10%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 — Loading #DIV/0! (Rated Current =A)

Voltage V_{r3}: 31.2kV (10%Drop)

<Branch Line 1>

Load L_{B1}	47A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B1}	4605kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage — I_{max} : Maximum Current — $R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
V_{i1} : Interim Voltage — L_{T1} : Load (Trunk line 1) — $X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
V_{i2} : Interim Voltage — L_{T2} : Load (Trunk line 2) — $f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
V_{r1} : Received Voltage — L_{B1} : Load (Branch Line 1) — $CAP_{T1}, CAP_{T2}, CAP_{B1}$, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage — L_{B2} : Load (Branch Line 2)
V_{r3} : Received Voltage — L_{B3} : Load (Branch Line 3) — cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	FOSU

: Input data in colored cells

Type-3

Maximum Current I_{max}
165A

Power factor (cosθ)
0.86

<Trank Line 1>

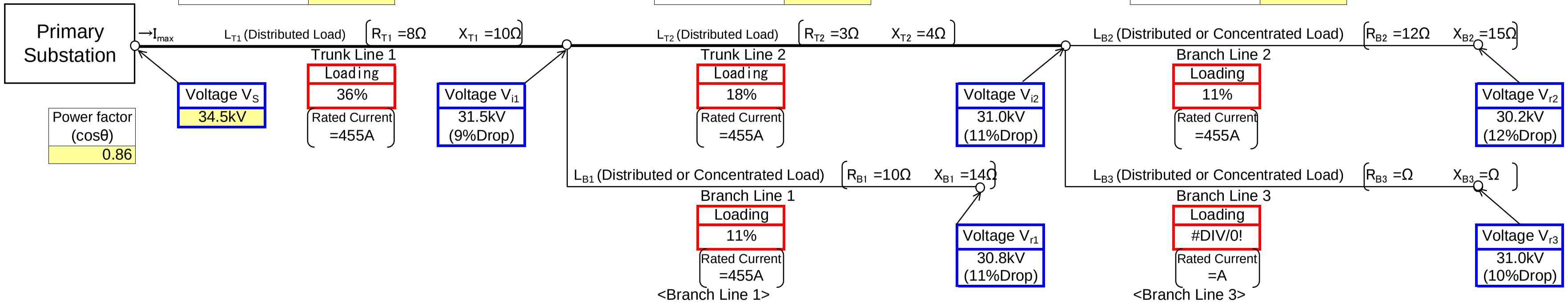
Load L_{T1}	34A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	28km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	3125kVA	

<Trank Line 2>

Load L_{T2}	32A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2950kVA	

<Branch Line 2>

Load L_{B2}	50A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	43km	
Total Transformer Capacity of secondary substations CAP_{B2}	4605kVA	



<Branch Line 1>

Load L_{B1}	50A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B1}	4605kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	FOSU

: Input data in colored cells

Type-3

Maximum Current I_{max}
173A

Power factor (cosθ)
0.86

Primary Substation →I_{max}

Voltage V_s: 34.5kV

<Trank Line 1>

Load L_{T1}	35A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	28km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	3125kVA	

L_{T1} (Distributed Load) (R_{T1} =8Ω X_{T1} =10Ω)

Trunk Line 1 — Loading 38% — Rated Current =455A

Voltage V_{i1}: 31.4kV (9%Drop)

<Trank Line 2>

Load L_{T2}	33A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2950kVA	

L_{T2} (Distributed Load) (R_{T2} =3Ω X_{T2} =4Ω)

Trunk Line 2 — Loading 19% — Rated Current =455A

Voltage V_{i2}: 30.8kV (12%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =10Ω X_{B1} =14Ω)

Branch Line 1 — Loading 11% — Rated Current =455A

Voltage V_{r1}: 30.7kV (11%Drop)

<Branch Line 1>

Load L_{B1}	52A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B1}	4605kVA	

<Branch Line 2>

Load L_{B2}	52A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	43km	
Total Transformer Capacity of secondary substations CAP_{B2}	4605kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =12Ω X_{B2} =15Ω)

Branch Line 2 — Loading 11% — Rated Current =455A

Voltage V_{r2}: 30.0kV (13%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 — Loading #DIV/0! — Rated Current =A

Voltage V_{r3}: 30.8kV (11%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	FOSU

: Input data in colored cells

Type-3

Maximum Current I_{max}
182A

Power factor (cosθ)
0.86

<Trank Line 1>

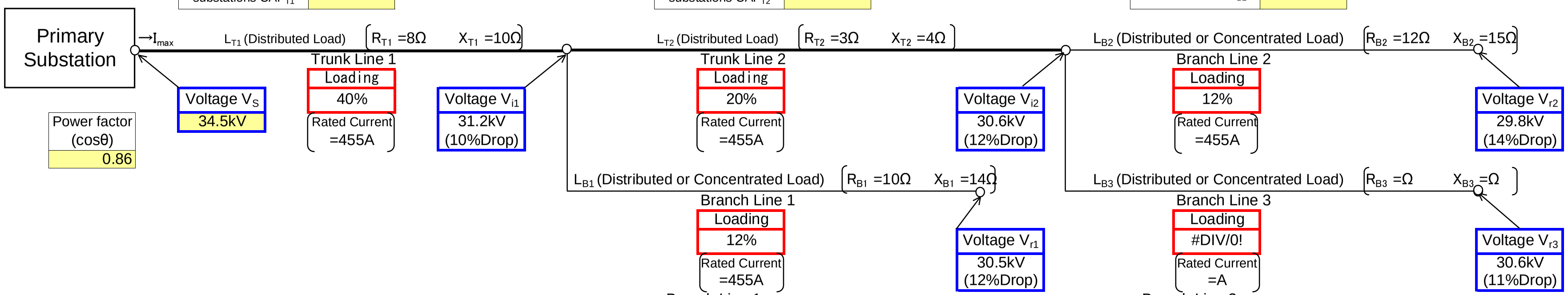
Load L_{T1}	37A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	28km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	3125kVA	

<Trank Line 2>

Load L_{T2}	35A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2950kVA	

<Branch Line 2>

Load L_{B2}	55A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	43km	
Total Transformer Capacity of secondary substations CAP_{B2}	4605kVA	



<Branch Line 1>

Load L_{B1}	55A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B1}	4605kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	FOSU

: Input data in colored cells

Type-3

Primary Substation

Maximum Current I_{max}
191A

Power factor (cosθ)
0.86

Voltage V_s
34.5kV

<Trank Line 1>

Load L_{T1}	39A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	28km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	3125kVA	

$\rightarrow I_{max}$ L_{T1} (Distributed Load) R_{T1} =8Ω X_{T1} =10Ω

Trunk Line 1: Loading 42%; Rated Current =455A

Voltage V_{i1}: 31.0kV (10%Drop)

<Trank Line 2>

Load L_{T2}	37A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2950kVA	

L_{T2} (Distributed Load) R_{T2} =3Ω X_{T2} =4Ω

Trunk Line 2: Loading 21%; Rated Current =455A

Voltage V_{i2}: 30.4kV (13%Drop)

<Branch Line 2>

Load L_{B2}	58A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	43km	
Total Transformer Capacity of secondary substations CAP_{B2}	4605kVA	

L_{B2} (Distributed or Concentrated Load) R_{B2} =12Ω X_{B2} =15Ω

Branch Line 2: Loading 13%; Rated Current =455A

Voltage V_{r2}: 29.5kV (14%Drop)

L_{B1} (Distributed or Concentrated Load) R_{B1} =10Ω X_{B1} =14Ω

Branch Line 1: Loading 13%; Rated Current =455A

Voltage V_{r1}: 30.3kV (12%Drop)

<Branch Line 1>

Load L_{B1}	58A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B1}	4605kVA	

L_{B3} (Distributed or Concentrated Load) R_{B3} =Ω X_{B3} =Ω

Branch Line 3: Loading #DIV/0!; Rated Current =A

Voltage V_{r3}: 30.4kV (12%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	TOKUSE
Feeder Name	KASOA

: Input data in colored cells

Type-3

Maximum Current I_{max}
227A

Power factor (cosθ)
0.86

<Trank Line 1>

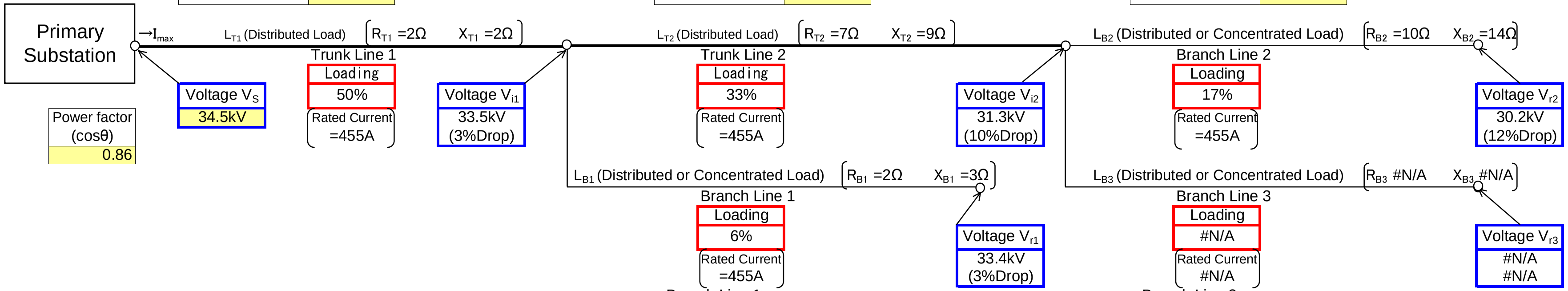
Load L_{T1}	48A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	8765kVA	

<Trank Line 2>

Load L_{T2}	73A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	26km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	13315kVA	

<Branch Line 2>

Load L_{B2}	78A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B2}	14210kVA	



<Branch Line 1>

Load L_{B1}	27A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4900kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type		#N/A
Type of Load	Equality	
Line Length Len_{B3}		
Total Transformer Capacity of secondary substations CAP_{B3}		

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	TOKUSE
Feeder Name	KASOA

: Input data in colored cells

Type-3

Maximum Current I_{max}
238A

Power factor (cosθ)
0.86

<Trank Line 1>

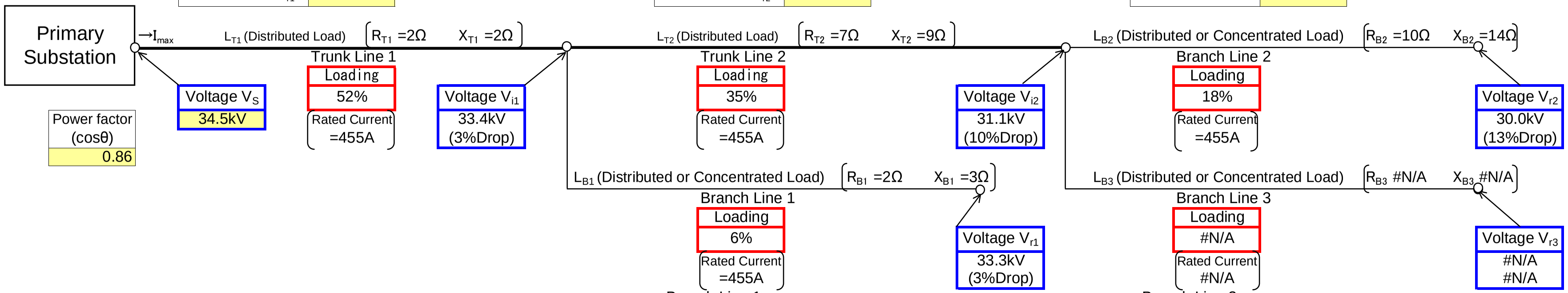
Load L_{T1}	51A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	8765kVA	

<Trank Line 2>

Load L_{T2}	77A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	26km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	13315kVA	

<Branch Line 2>

Load L_{B2}	82A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B2}	14210kVA	



<Branch Line 1>

Load L_{B1}	28A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4900kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type		#N/A
Type of Load	Equality	
Line Length Len_{B3}		
Total Transformer Capacity of secondary substations CAP_{B3}		

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	TOKUSE
Feeder Name	KASOA

: Input data in colored cells

Type-3

Maximum Current I_{max}
249A

<Trank Line 1>

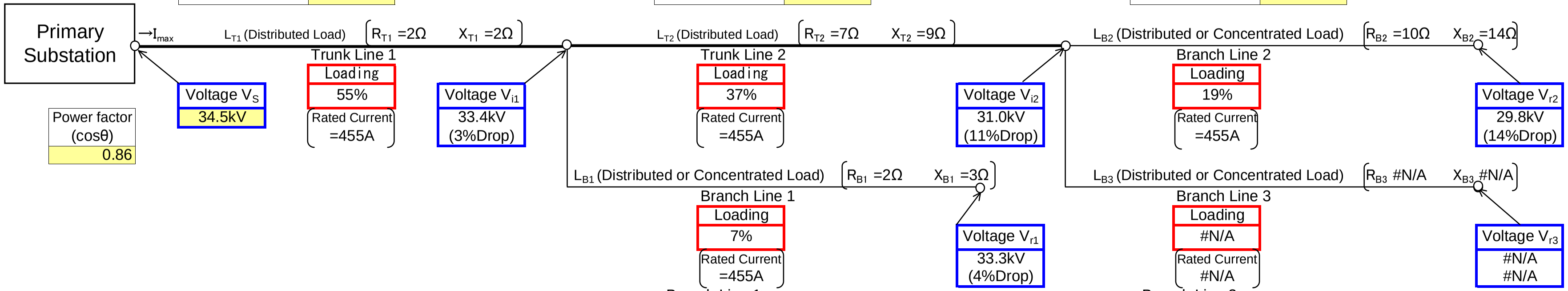
Load L_{T1}	53A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	8765kVA	

<Trank Line 2>

Load L_{T2}	80A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	26km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	13315kVA	

<Branch Line 2>

Load L_{B2}	86A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B2}	14210kVA	



<Branch Line 1>

Load L_{B1}	30A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4900kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type		#N/A
Type of Load	Equality	
Line Length Len_{B3}		
Total Transformer Capacity of secondary substations CAP_{B3}		

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	TOKUSE
Feeder Name	KASOA

: Input data in colored cells

Type-3

Maximum Current I_{max}	262A
Power factor (cosθ)	0.86

<Trank Line 1>

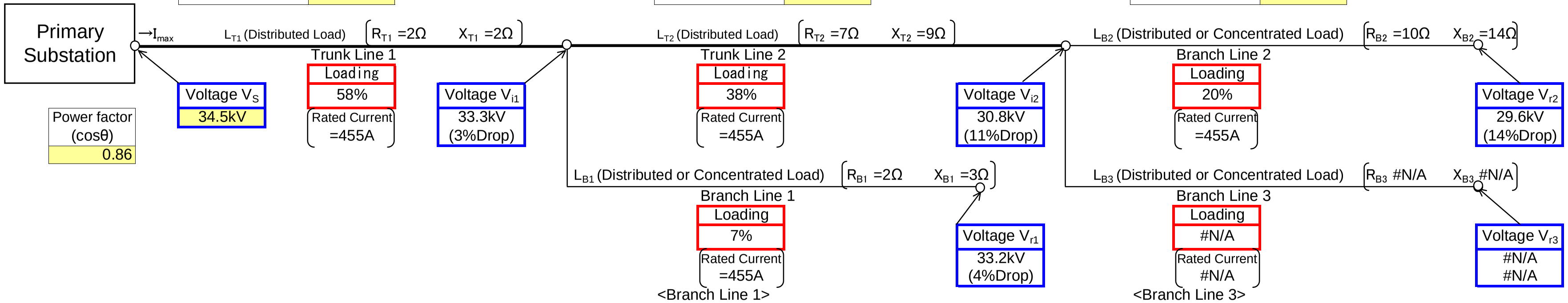
Load L_{T1}	56A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	8765kVA	

<Trank Line 2>

Load L_{T2}	85A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	26km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	13315kVA	

<Branch Line 2>

Load L_{B2}	90A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B2}	14210kVA	



<Branch Line 1>

Load L_{B1}	31A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4900kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type		#N/A
Type of Load	Equality	
Line Length Len_{B3}		
Total Transformer Capacity of secondary substations CAP_{B3}		

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	TOKUSE
Feeder Name	KASOA

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	58A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	8765kVA	

<Trank Line 2>

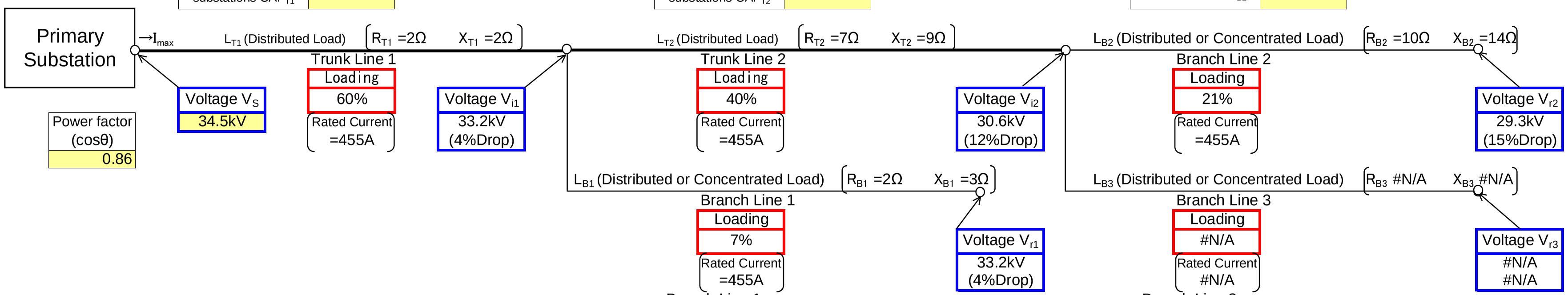
Load L_{T2}	89A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	26km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	13315kVA	

<Branch Line 2>

Load L_{B2}	95A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B2}	14210kVA	

Maximum Current I_{max}
274A

Power factor (cosθ)
0.86



<Branch Line 1>

Load L_{B1}	33A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4900kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type		#N/A
Type of Load	Equality	
Line Length Len_{B3}		
Total Transformer Capacity of secondary substations CAP_{B3}		

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	TOKUSE
Feeder Name	KASOA

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	61A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	8765kVA	

<Trank Line 2>

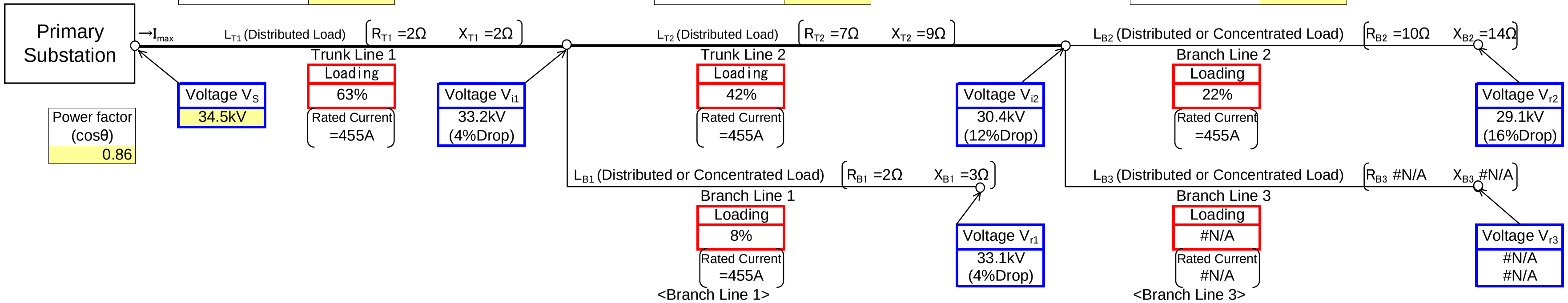
Load L_{T2}	93A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	26km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	13315kVA	

<Branch Line 2>

Load L_{B2}	99A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B2}	14210kVA	

Maximum Current I_{max}
288A

Power factor (cosθ)
0.86



<Branch Line 1>

Load L_{B1}	34A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4900kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type		#N/A
Type of Load	Equality	
Line Length Len_{B3}		
Total Transformer Capacity of secondary substations CAP_{B3}		

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	TOKUSE
Feeder Name	KASOA

(yellow): Input data in colored cells

Type-3

Maximum Current I_{max}
302A

Power factor (cosθ)
0.86

<Trank Line 1>

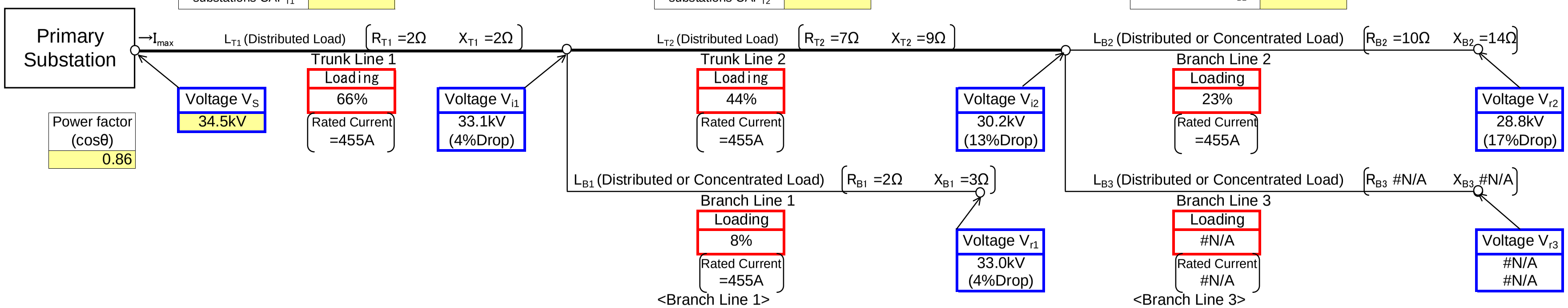
Load L_{T1}	64A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	8765kVA	

<Trank Line 2>

Load L_{T2}	98A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	26km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	13315kVA	

<Branch Line 2>

Load L_{B2}	104A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B2}	14210kVA	



<Branch Line 1>

Load L_{B1}	36A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4900kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type		#N/A
Type of Load	Equality	
Line Length Len_{B3}		
Total Transformer Capacity of secondary substations CAP_{B3}		

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	TOKUSE
Feeder Name	KASOA

: Input data in colored cells

Type-3

Maximum Current I_{max}: 317A

Power factor (cosθ): 0.86

<Trank Line 1>

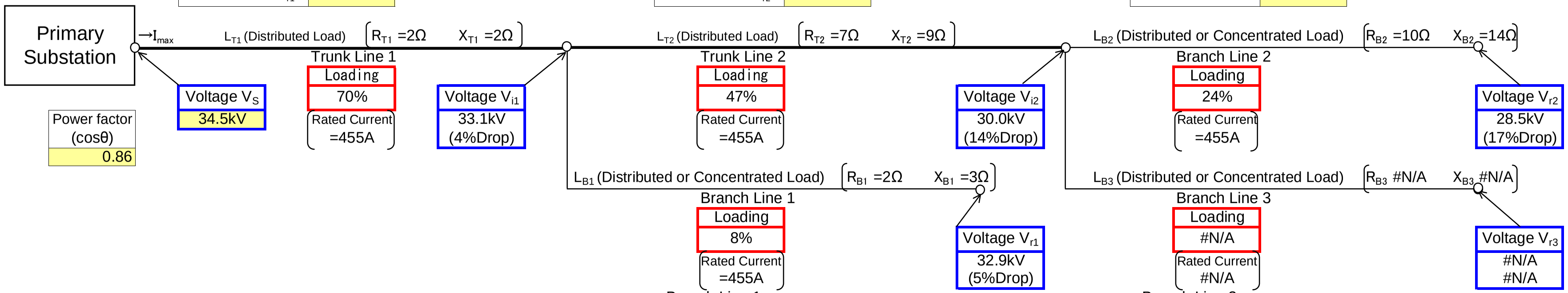
Load L_{T1}	67A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	8765kVA	

<Trank Line 2>

Load L_{T2}	102A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	26km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	13315kVA	

<Branch Line 2>

Load L_{B2}	109A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B2}	14210kVA	



<Branch Line 1>

Load L_{B1}	38A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4900kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type		#N/A
Type of Load	Equality	
Line Length Len_{B3}		
Total Transformer Capacity of secondary substations CAP_{B3}		

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	TOKUSE
Feeder Name	KASOA

: Input data in colored cells

Type-3

Maximum Current I_{max}	
332A	

Power factor (cosθ)	
0.86	

<Trank Line 1>

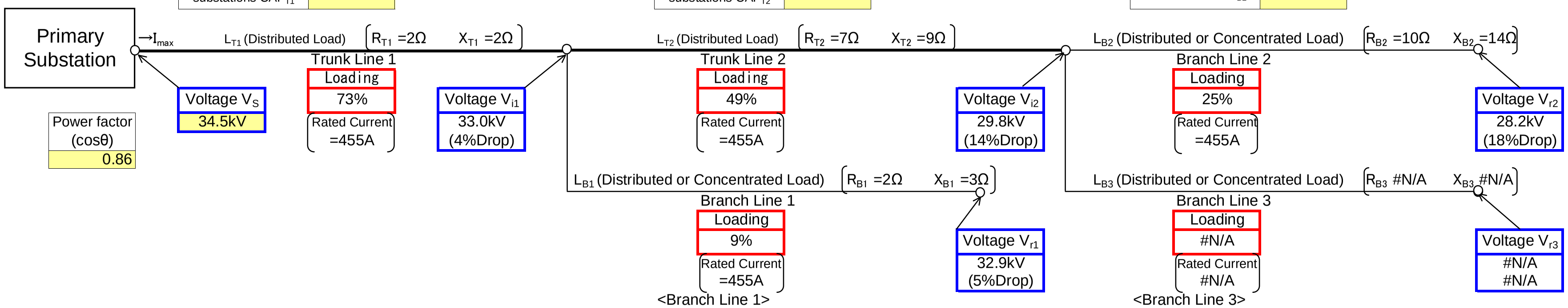
Load L_{T1}	71A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	8765kVA	

<Trank Line 2>

Load L_{T2}	107A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	26km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	13315kVA	

<Branch Line 2>

Load L_{B2}	115A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B2}	14210kVA	



<Branch Line 1>

Load L_{B1}	39A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4900kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type		#N/A
Type of Load	Equality	
Line Length Len_{B3}		
Total Transformer Capacity of secondary substations CAP_{B3}		

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1} CAP_{B2}, CAP_{B3}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)		
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	TOKUSE
Feeder Name	KASOA

: Input data in colored cells

Type-3

Maximum Current I_{max}: 349A

Power factor (cosθ): 0.86

<Trank Line 1>

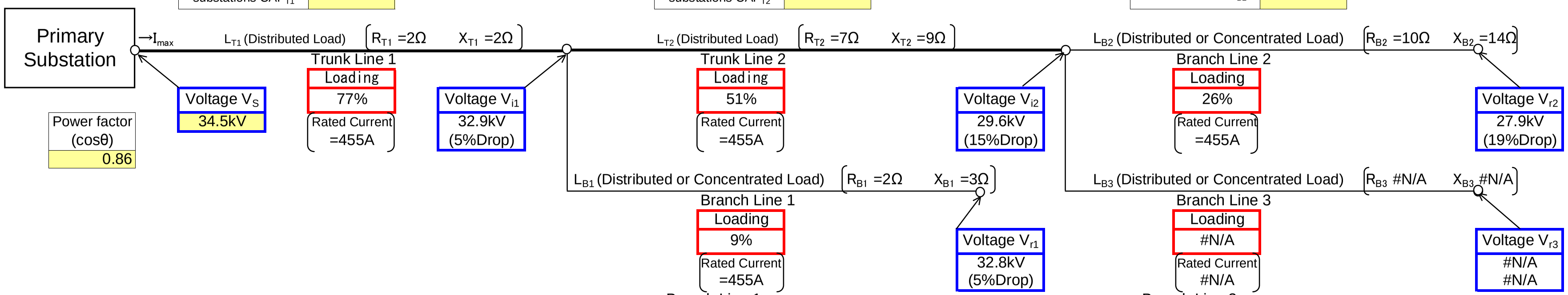
Load L_{T1}	74A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	8765kVA	

<Trank Line 2>

Load L_{T2}	113A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	26km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	13315kVA	

<Branch Line 2>

Load L_{B2}	120A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B2}	14210kVA	



<Branch Line 1>

Load L_{B1}	42A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4900kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type		#N/A
Type of Load	Equality	
Line Length Len_{B3}		
Total Transformer Capacity of secondary substations CAP_{B3}		

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage
V_{i1} : Interim Voltage
V_{i2} : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
V_{r3} : Received Voltage

I_{max} : Maximum Current
L_{T1} : Load (Trunk line 1)
L_{T2} : Load (Trunk line 2)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
L_{B3} : Load (Branch Line 3)

$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
$CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3}$: Total Transformer Capacity of secondary substations
cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	TOKUSE
Feeder Name	KASOA

: Input data in colored cells

Type-3

Maximum Current I_{max}	Power factor (cosθ)
366A	0.86

<Trank Line 1>

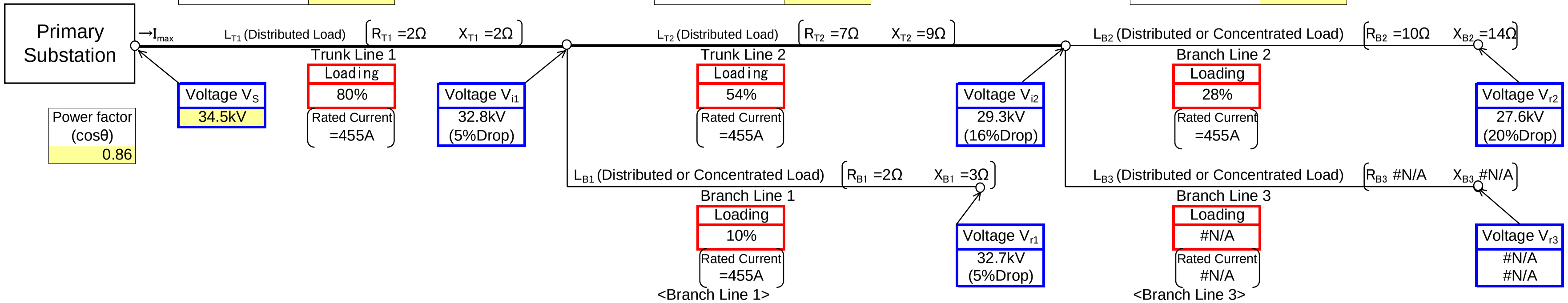
Load L_{T1}	78A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	8765kVA	

<Trank Line 2>

Load L_{T2}	118A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	26km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	13315kVA	

<Branch Line 2>

Load L_{B2}	126A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B2}	14210kVA	



<Branch Line 1>

Load L_{B1}	44A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4900kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type		#N/A
Type of Load	Equality	
Line Length Len_{B3}		
Total Transformer Capacity of secondary substations CAP_{B3}		

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	TOKUSE
Feeder Name	KASOA

: Input data in colored cells

Type-3

Maximum Current I_{max}
384A

Power factor (cosθ)
0.86

Primary Substation

Voltage V_s
34.5kV

<Trank Line 1>

Load L_{T1}	82A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Received Larger	
Total Transformer Capacity of secondary substations CAP_{T1}	8765kVA	

$\rightarrow I_{max}$ L_{T1} (Distributed Load) (R_{T1} =2Ω X_{T1} =2Ω)

Trunk Line 1: Loading 84%; Rated Current =455A

Voltage V_{i1}
32.7kV (5%Drop)

<Trank Line 2>

Load L_{T2}	124A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	26km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	13315kVA	

L_{T2} (Distributed Load) (R_{T2} =7Ω X_{T2} =9Ω)

Trunk Line 2: Loading 56%; Rated Current =455A

Voltage V_{i2}
29.1kV (17%Drop)

<Branch Line 2>

Load L_{B2}	132A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B2}	14210kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =10Ω X_{B2} =14Ω)

Branch Line 2: Loading 29%; Rated Current =455A

Voltage V_{r2}
27.3kV (21%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =2Ω X_{B1} =3Ω)

Branch Line 1: Loading 10%; Rated Current =455A

Voltage V_{r1}
32.6kV (5%Drop)

<Branch Line 1>

Load L_{B1}	46A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4900kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} #N/A X_{B3} #N/A)

Branch Line 3: Loading #N/A; Rated Current #N/A

Voltage V_{r3}
#N/A
#N/A

<Branch Line 3>

Load L_{B3}	A	
Line Type		#N/A
Type of Load	Equality	
Line Length Len_{B3}		
Total Transformer Capacity of secondary substations CAP_{B3}		

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	SALTPOND
Feeder Name	MANKESSIM

: Input data in colored cells

Type-3

Maximum Current I_{max}
118A

Power factor (cosθ)
0.86

<Trank Line 1>

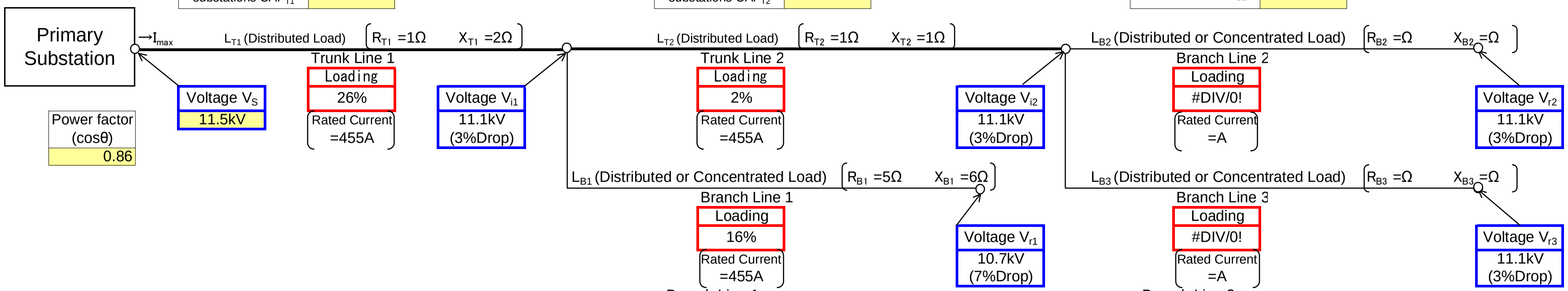
Load L_{T1}	37A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1050kVA	

<Trank Line 2>

Load L_{T2}	9A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	250kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	72A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	17km	
Total Transformer Capacity of secondary substations CAP_{B1}	2050kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	MANKESSIM

: Input data in colored cells

Type-3

Maximum Current I_{max}
124A

Power factor (cosθ)
0.86

<Trank Line 1>

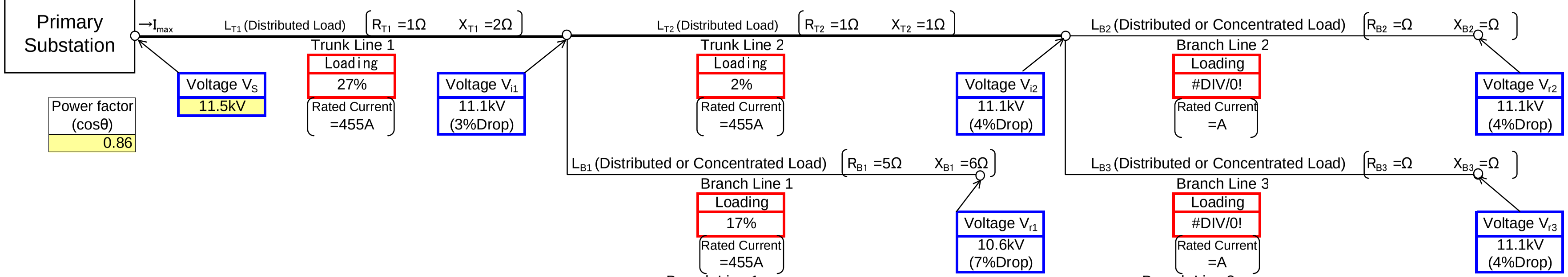
Load L_{T1}	39A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1050kVA	

<Trank Line 2>

Load L_{T2}	9A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	250kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	76A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	17km	
Total Transformer Capacity of secondary substations CAP_{B1}	2050kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	SALTPOND
Feeder Name	MANKESSIM

: Input data in colored cells

Type-3

Maximum Current I_{max}	131A	
Power factor (cosθ)	0.86	

<Trank Line 1>

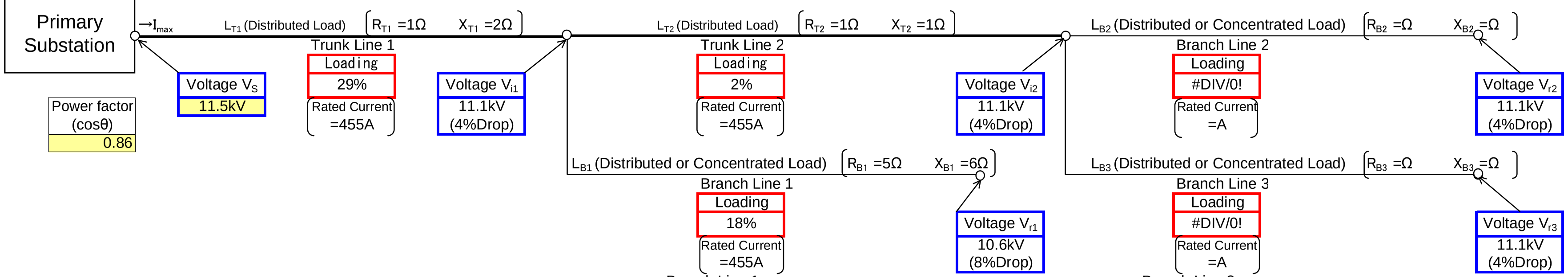
Load L_{T1}	41A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1050kVA	

<Trank Line 2>

Load L_{T2}	10A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	250kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	80A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	17km	
Total Transformer Capacity of secondary substations CAP_{B1}	2050kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ : Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	SALTPOND
Feeder Name	MANKESSIM

: Input data in colored cells

Type-3

Maximum Current I_{max}
138A

Power factor (cosθ)
0.86

<Trank Line 1>

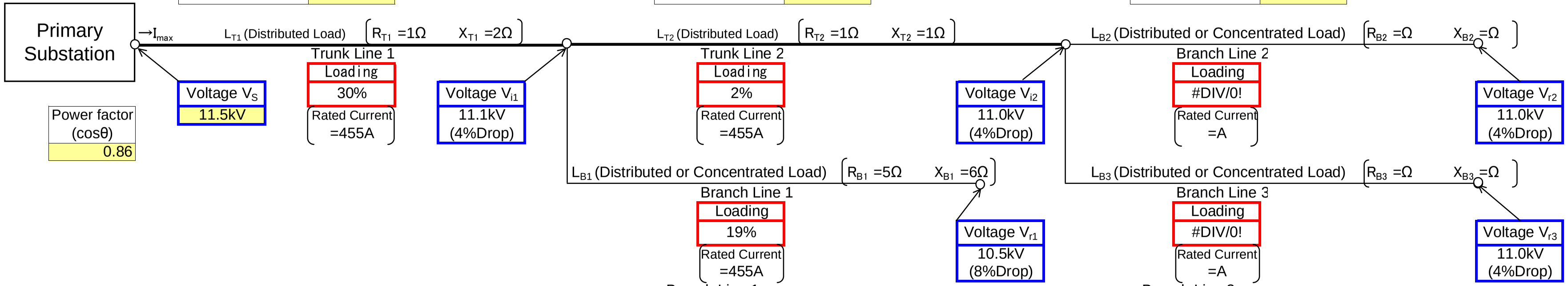
Load L_{T1}	43A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1050kVA	

<Trank Line 2>

Load L_{T2}	10A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	250kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	84A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	17km	
Total Transformer Capacity of secondary substations CAP_{B1}	2050kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	SALTPOND
Feeder Name	MANKESSIM

: Input data in colored cells

Type-3

Maximum Current I_{max}	145A
Power factor (cosθ)	0.86

<Trank Line 1>

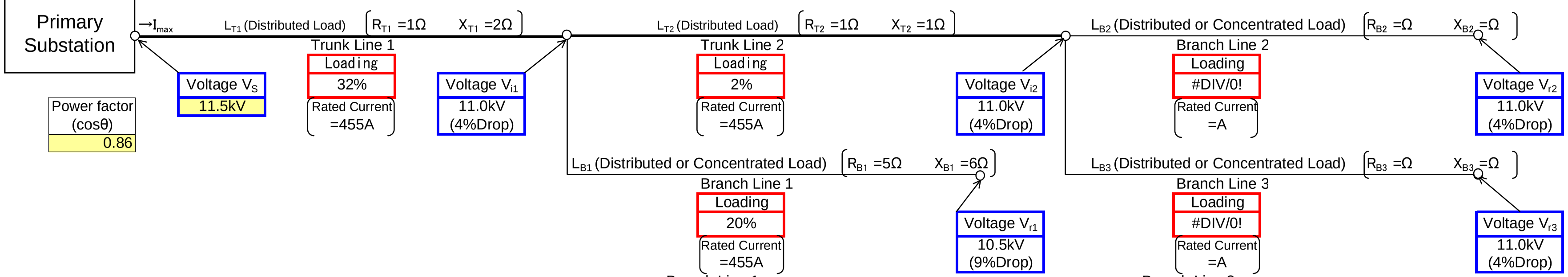
Load L_{T1}	45A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1050kVA	

<Trank Line 2>

Load L_{T2}	11A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	250kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	89A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	17km	
Total Transformer Capacity of secondary substations CAP_{B1}	2050kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	MANKESSIM

: Input data in colored cells

Type-3

Maximum Current I_{max}
153A

Power factor ($\cos\theta$)
0.86

<Trank Line 1>

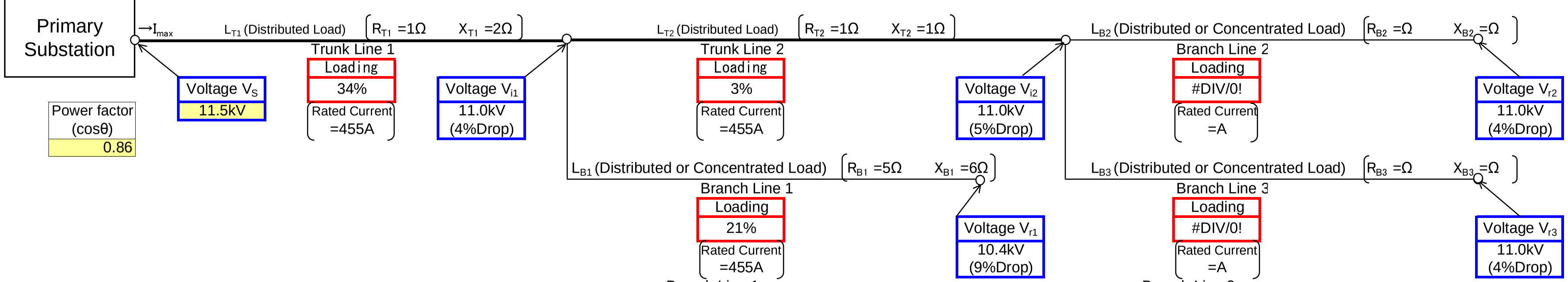
Load L_{T1}	48A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1050kVA	

<Trank Line 2>

Load L_{T2}	11A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	250kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	94A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	17km	
Total Transformer Capacity of secondary substations CAP_{B1}	2050kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	$\cos\theta$	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	MANKESSIM

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	50A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1050kVA	

<Trank Line 2>

Load L_{T2}	12A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	250kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}	161A
Power factor (cosθ)	0.86

Primary Substation $\rightarrow I_{max}$

Voltage V_S: 11.5kV

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =2Ω)
Trunk Line 1 — Loading 35% — Rated Current =455A

Voltage V_{i1}: 11.0kV (4%Drop)

L_{T2} (Distributed Load) (R_{T2} =1Ω X_{T2} =1Ω)
Trunk Line 2 — Loading 3% — Rated Current =455A

Voltage V_{i2}: 11.0kV (5%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)
Branch Line 2 — Loading #DIV/0! — Rated Current =A

Voltage V_{r2}: 11.0kV (5%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =5Ω X_{B1} =6Ω)
Branch Line 1 — Loading 22% — Rated Current =455A

Voltage V_{r1}: 10.4kV (10%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)
Branch Line 3 — Loading #DIV/0! — Rated Current =A

Voltage V_{r3}: 11.0kV (5%Drop)

<Branch Line 1>

Load L_{B1}	99A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	17km	
Total Transformer Capacity of secondary substations CAP_{B1}	2050kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	MANKESSIM

: Input data in colored cells

Type-3

Maximum Current I_{max}
169A

Power factor (cosθ)
0.86

<Trank Line 1>

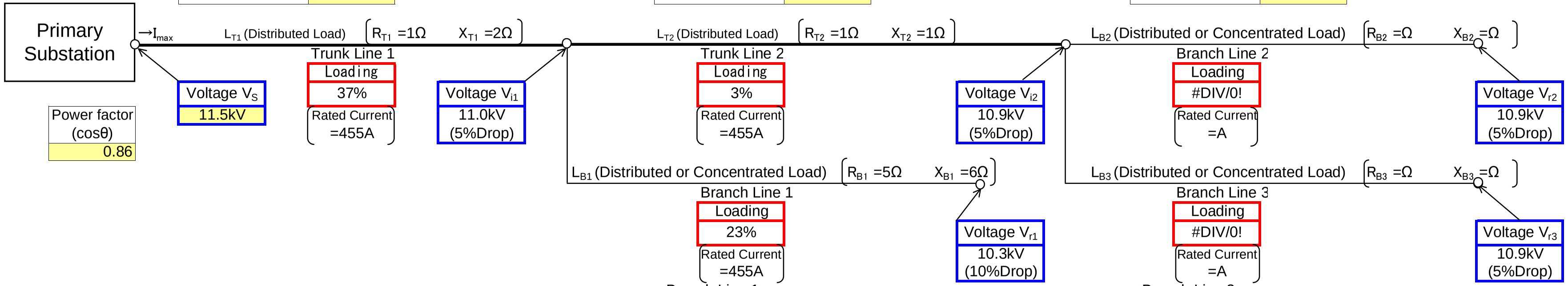
Load L_{T1}	53A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1050kVA	

<Trank Line 2>

Load L_{T2}	13A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	250kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	103A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	17km	
Total Transformer Capacity of secondary substations CAP_{B1}	2050kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	MANKESSIM

: Input data in colored cells

Type-3

Maximum Current I_{max}
178A

Power factor (cosθ)
0.86

<Trank Line 1>

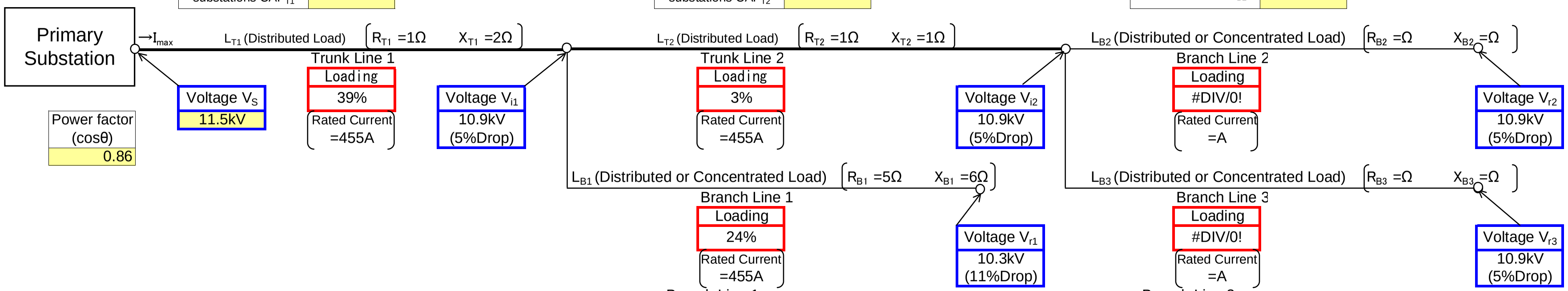
Load L_{T1}	56A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1050kVA	

<Trank Line 2>

Load L_{T2}	13A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	250kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	109A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	17km	
Total Transformer Capacity of secondary substations CAP_{B1}	2050kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	SALTPOND
Feeder Name	MANKESSIM

: Input data in colored cells

Type-3

Maximum Current I_{max}
187A

Power factor ($\cos\theta$)
0.86

<Trank Line 1>

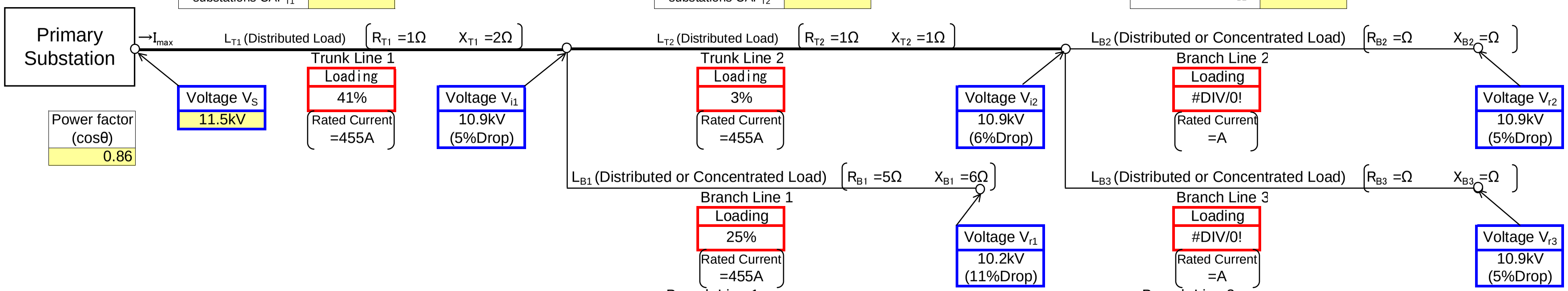
Load L_{T1}	59A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1050kVA	

<Trank Line 2>

Load L_{T2}	14A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	250kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	114A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	17km	
Total Transformer Capacity of secondary substations CAP_{B1}	2050kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	$\cos\theta$	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	MANKESSIM

: Input data in colored cells

Type-3

Maximum Current I_{max}
197A

Power factor ($\cos\theta$)
0.86

<Trank Line 1>

Load L_{T1}	62A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1050kVA	

<Trank Line 2>

Load L_{T2}	15A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	250kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Primary Substation →I_{max}

Voltage V_s: 11.5kV

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =2Ω)

Trunk Line 1 — Loading 43% — Rated Current =455A

Voltage V_{i1}: 10.9kV (6%Drop)

L_{T2} (Distributed Load) (R_{T2} =1Ω X_{T2} =1Ω)

Trunk Line 2 — Loading 3% — Rated Current =455A

Voltage V_{i2}: 10.9kV (6%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2 — Loading #DIV/0! — Rated Current =A

Voltage V_{r2}: 10.9kV (6%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =5Ω X_{B1} =6Ω)

Branch Line 1 — Loading 26% — Rated Current =455A

Voltage V_{r1}: 10.1kV (12%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 — Loading #DIV/0! — Rated Current =A

Voltage V_{r3}: 10.9kV (6%Drop)

<Branch Line 1>

Load L_{B1}	121A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	17km	
Total Transformer Capacity of secondary substations CAP_{B1}	2050kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	$\cos\theta$	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	MANKESSIM

: Input data in colored cells

Type-3

Maximum Current I_{max}
208A

Power factor (cosθ)
0.86

<Trank Line 1>

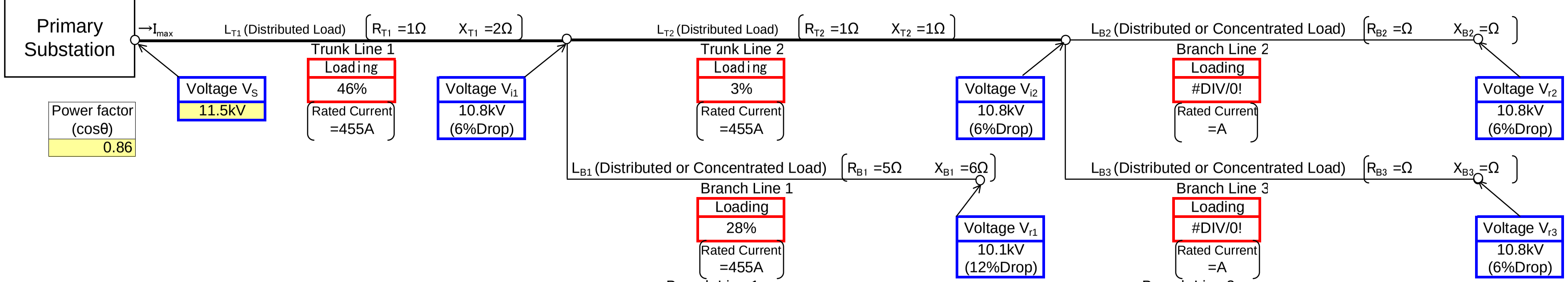
Load L_{T1}	65A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1050kVA	

<Trank Line 2>

Load L_{T2}	16A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	250kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	127A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	17km	
Total Transformer Capacity of secondary substations CAP_{B1}	2050kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
280A

Power factor (cosθ)
0.86

<Trank Line 1>

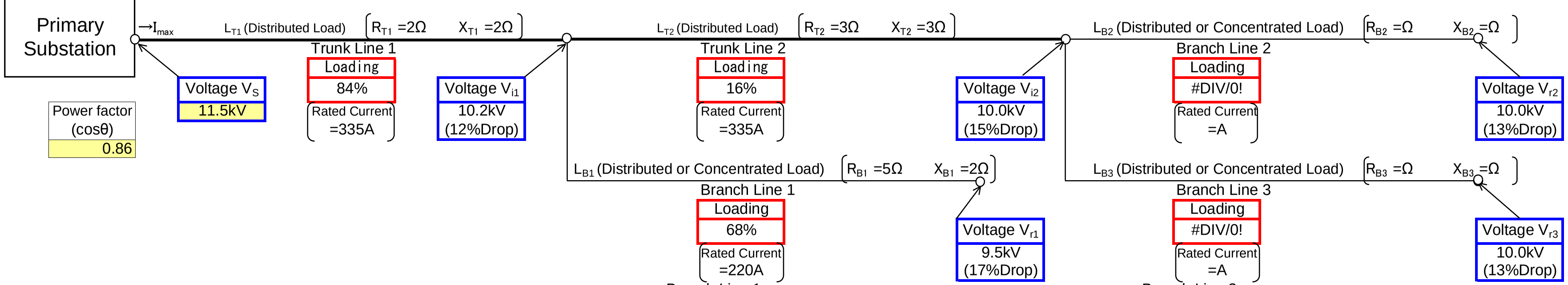
Load L_{T1}	76A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	17km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2950kVA	

<Trank Line 2>

Load L_{T2}	54A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	21km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2075kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	150A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	5795kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 1

: Input data in colored cells

Type-3

Maximum Current I_{max}	190A
Power factor (cosθ)	0.86

<Trank Line 1>

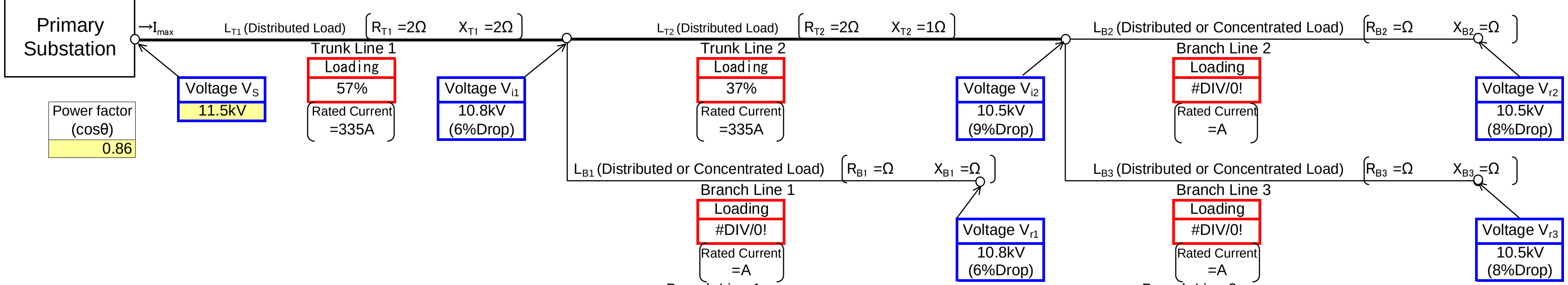
Load L_{T1}	65A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1225kVA	

<Trank Line 2>

Load L_{T2}	125A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	12km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2345kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

Substation Name	SALTPOND
Feeder Name	ANOMABO

: Input data in colored cells

Type-3

Maximum Current I_{max}
38A

Power factor (cosθ)
0.86

<Trank Line 1>

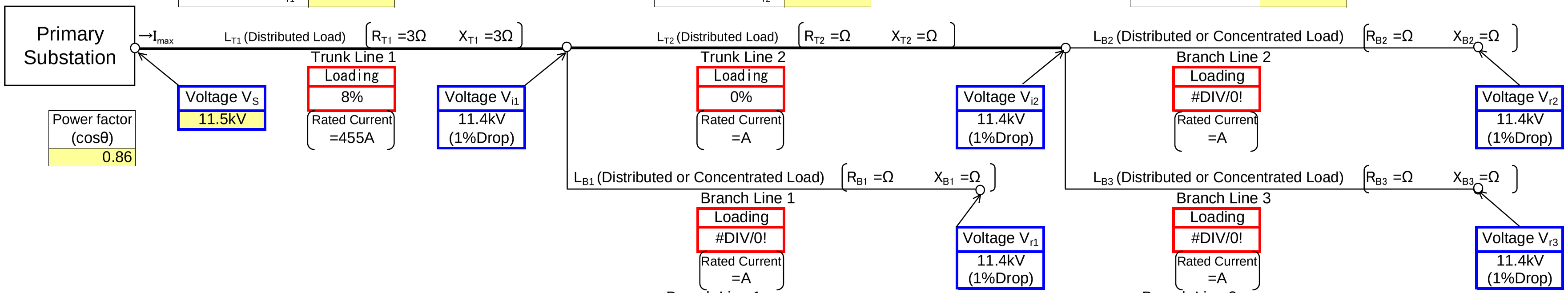
Load L_{T1}	38A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1350kVA	

<Trank Line 2>

Load L_{T2}	A	
Line Type	None	No.33
Line Legth Len_{T2}	km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

Substation Name	SALTPOND
Feeder Name	MANKESSIM

: Input data in colored cells

Type-3

Maximum Current I_{max}
128A

Power factor (cosθ)
0.86

<Trank Line 1>

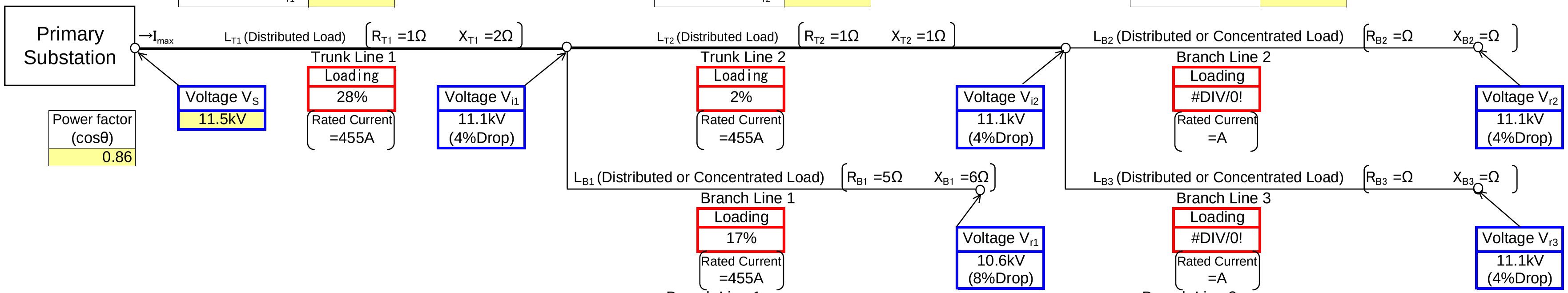
Load L_{T1}	40A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1050kVA	

<Trank Line 2>

Load L_{T2}	10A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	250kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	78A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	17km	
Total Transformer Capacity of secondary substations CAP_{B1}	2050kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}	
47A	

Primary Substation

Power factor (cosθ)
0.86

Voltage V_s: 11.5kV

<Trank Line 1>

Load L_{T1}	24A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	980kVA	

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)

Trunk Line 1 — Loading 10% — (Rated Current =455A)

Voltage V_{i1}: 11.4kV (1%Drop)

<Trank Line 2>

Load L_{T2}	23A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	950kVA	

L_{T2} (Distributed Load) (R_{T2} =2Ω X_{T2} =2Ω)

Trunk Line 2 — Loading 5% — (Rated Current =455A)

Voltage V_{i2}: 11.4kV (1%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2 — Loading #DIV/0! — (Rated Current =A)

Voltage V_{r2}: 11.4kV (1%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1 — Loading #DIV/0! — (Rated Current =A)

Voltage V_{r1}: 11.4kV (1%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 — Loading #DIV/0! — (Rated Current =A)

Voltage V_{r3}: 11.4kV (1%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P
Feeder Name	APAM

: Input data in colored cells

Type-3

Maximum Current I_{max}
120A

Power factor (cosθ)
0.86

<Trank Line 1>

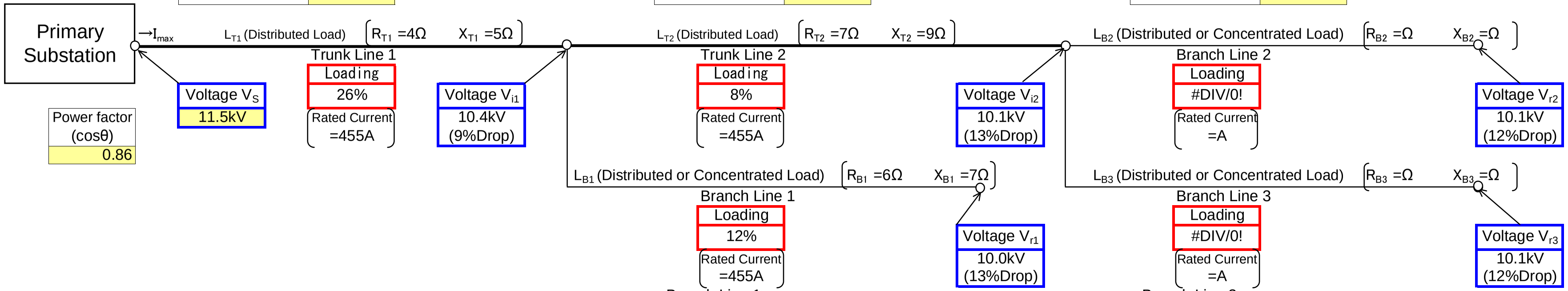
Load L_{T1}	29A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1465kVA	

<Trank Line 2>

Load L_{T2}	37A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	24km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	54A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	21km	
Total Transformer Capacity of secondary substations CAP_{B1}	2765kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	WINNEBA

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	166A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	15km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	4345kVA	

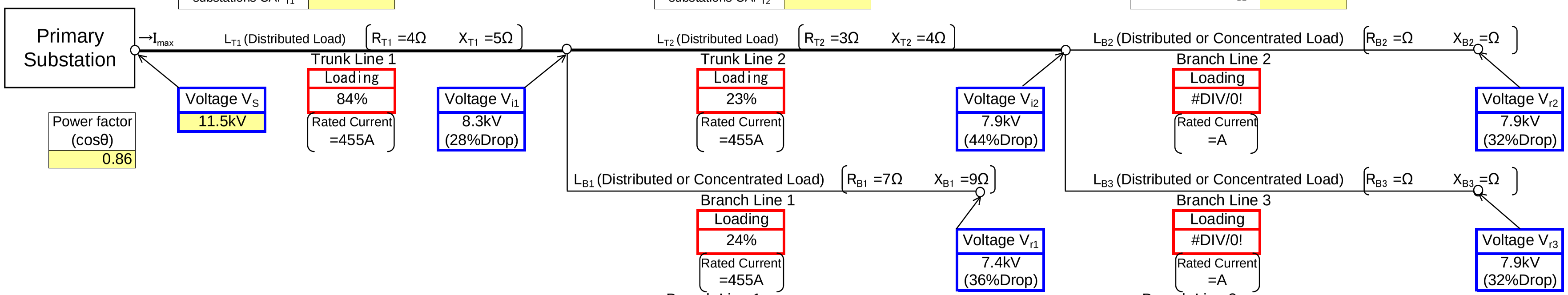
<Trank Line 2>

Load L_{T2}	105A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	12km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2765kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}	380A
Power factor (cosθ)	0.86



<Branch Line 1>

Load L_{B1}	109A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	24km	
Total Transformer Capacity of secondary substations CAP_{B1}	2865kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage
V_{i1} : Interim Voltage
V_{i2} : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
V_{r3} : Received Voltage

I_{max} : Maximum Current
L_{T1} : Load (Trunk line 1)
L_{T2} : Load (Trunk line 2)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
L_{B3} : Load (Branch Line 3)

R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3} : Resistance
X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3} : Reactance
f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3} : Dispersal Load Factor
CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	ASIKUMA

: Input data in colored cells

Type-3

Maximum Current I_{max}
330A

Power factor (cosθ)
0.86

Primary Substation

→I_{max}

Voltage V_s
11.5kV

<Trank Line 1>

Load L_{T1}	96A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)

Trunk Line 1: Loading 99%; Rated Current =335A

Voltage V_{i1}
11.1kV (4%Drop)

<Trank Line 2>

Load L_{T2}	78A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2030kVA	

L_{T2} (Distributed Load) (R_{T2} =1Ω X_{T2} =1Ω)

Trunk Line 2: Loading 23%; Rated Current =335A

Voltage V_{i2}
11.0kV (5%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2: Loading #DIV/0!; Rated Current =A

Voltage V_{r2}
11.0kV (4%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =3Ω X_{B1} =1Ω)

Branch Line 1: Loading 71%; Rated Current =220A

Voltage V_{r1}
10.7kV (7%Drop)

<Branch Line 1>

Load L_{B1}	156A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4070kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!; Rated Current =A

Voltage V_{r3}
11.0kV (4%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	PRASO

: Input data in colored cells

Type-3

Maximum Current I_{max}
54A

Power factor (cosθ)
0.86

<Trank Line 1>

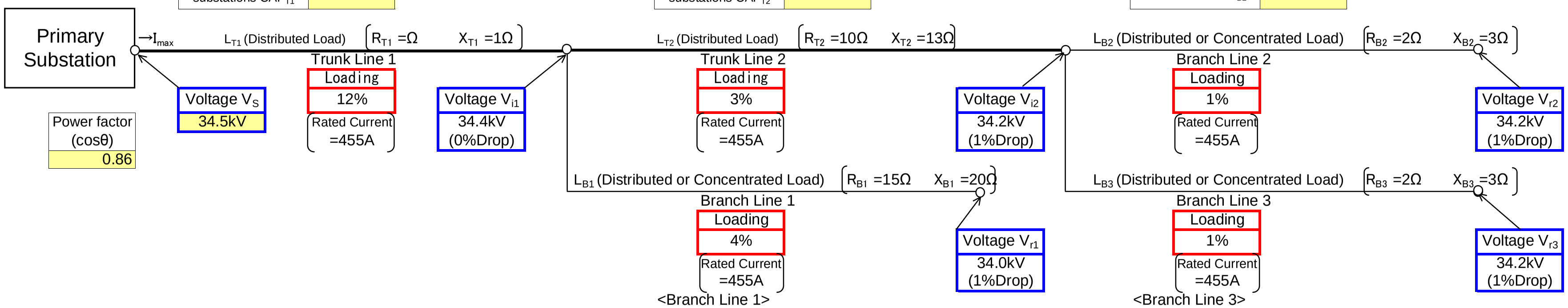
Load L_{T1}	20A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	5200kVA	

<Trank Line 2>

Load L_{T2}	7A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	37km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	3A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B2}	750kVA	



<Branch Line 1>

Load L_{B1}	20A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	56km	
Total Transformer Capacity of secondary substations CAP_{B1}	5350kVA	

<Branch Line 3>

Load L_{B3}	4A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	7km	
Total Transformer Capacity of secondary substations CAP_{B3}	1050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}	86A
Power factor (cosθ)	0.86

<Trank Line 1>

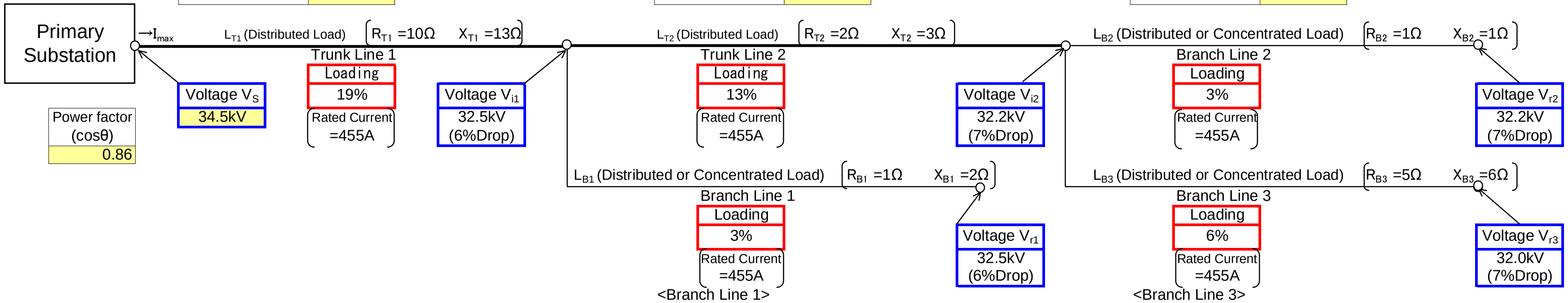
Load L_{T1}	17A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	35km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1300kVA	

<Trank Line 2>

Load L_{T2}	18A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1400kVA	

<Branch Line 2>

Load L_{B2}	13A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	3km	
Total Transformer Capacity of secondary substations CAP_{B2}	980kVA	



<Branch Line 1>

Load L_{B1}	12A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	5km	
Total Transformer Capacity of secondary substations CAP_{B1}	950kVA	

<Branch Line 3>

Load L_{B3}	26A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	18km	
Total Transformer Capacity of secondary substations CAP_{B3}	2050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	FOSU

: Input data in colored cells

Type-3

Maximum Current I_{max}
112A

Power factor (cosθ)
0.86

<Trank Line 1>

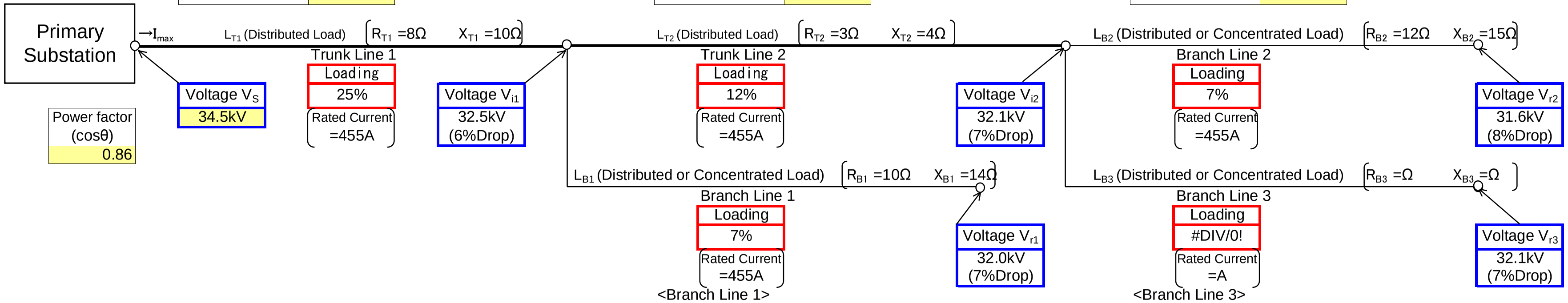
Load L_{T1}	23A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	28km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	3125kVA	

<Trank Line 2>

Load L_{T2}	22A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2950kVA	

<Branch Line 2>

Load L_{B2}	34A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	43km	
Total Transformer Capacity of secondary substations CAP_{B2}	4605kVA	



<Branch Line 1>

Load L_{B1}	34A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	38km	
Total Transformer Capacity of secondary substations CAP_{B1}	4605kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	cape coast B.S.P.
Feeder Name	RIDGES

: Input data in colored cells

Type-3

Maximum Current I_{max}
120A

Primary Substation

Power factor (cosθ)
0.86

Voltage V_s: 11.5kV

<Trank Line 1>

Load L_{T1}	14A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	200kVA	

→I_{max} L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)

Trunk Line 1: Loading 26%, Rated Current =455A

Voltage V_{i1}: 11.2kV (3%Drop)

<Trank Line 2>

Load L_{T2}	53A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	750kVA	

L_{T2} (Distributed Load) (R_{T2} =1Ω X_{T2} =1Ω)

Trunk Line 2: Loading 12%, Rated Current =455A

Voltage V_{i2}: 11.1kV (3%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2: Loading #DIV/0!, Rated Current =A

Voltage V_{r2}: 11.1kV (3%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =2Ω X_{B1} =2Ω)

Branch Line 1: Loading 12%, Rated Current =455A

Voltage V_{r1}: 11.1kV (4%Drop)

<Branch Line 1>

Load L_{B1}	53A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	6km	
Total Transformer Capacity of secondary substations CAP_{B1}	750kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!, Rated Current =A

Voltage V_{r3}: 11.1kV (3%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

- V_s : Supply Voltage
- V_{i1} : Interim Voltage
- V_{i2} : Interim Voltage
- V_{r1} : Received Voltage
- V_{r2} : Received Voltage
- V_{r3} : Received Voltage
- I_{max} : Maximum Current
- L_{T1} : Load (Trunk line 1)
- L_{T2} : Load (Trunk line 2)
- L_{B1} : Load (Branch Line 1)
- L_{B2} : Load (Branch Line 2)
- L_{B3} : Load (Branch Line 3)
- R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3} : Resistance
- X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3} : Reactance
- f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3} : Dispersal Load Factor
- CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
- cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	ELMINA

: Input data in colored cells

Type-3

Maximum Current I_{max}
320A

Power factor (cosθ)
0.86

<Trank Line 1>

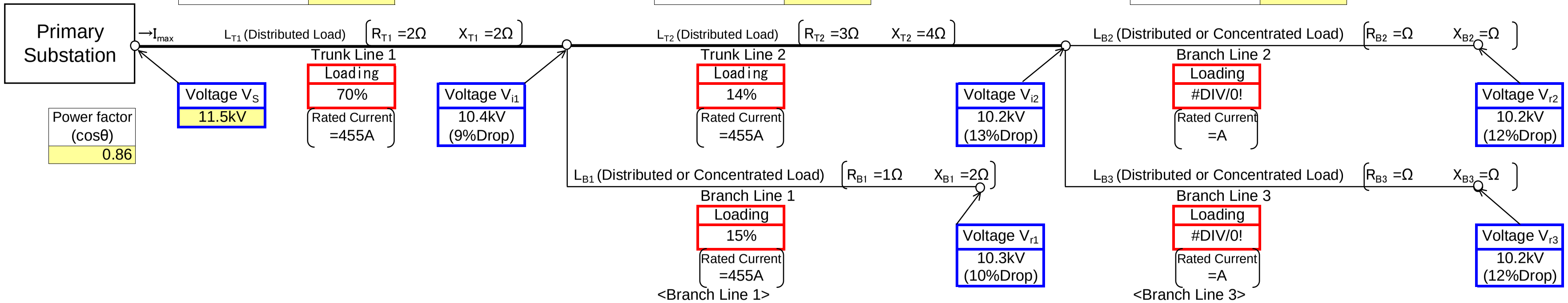
Load L_{T1}	188A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	7525kVA	

<Trank Line 2>

Load L_{T2}	63A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	11km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2500kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	69A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	4km	
Total Transformer Capacity of secondary substations CAP_{B1}	2750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 3

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	53A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

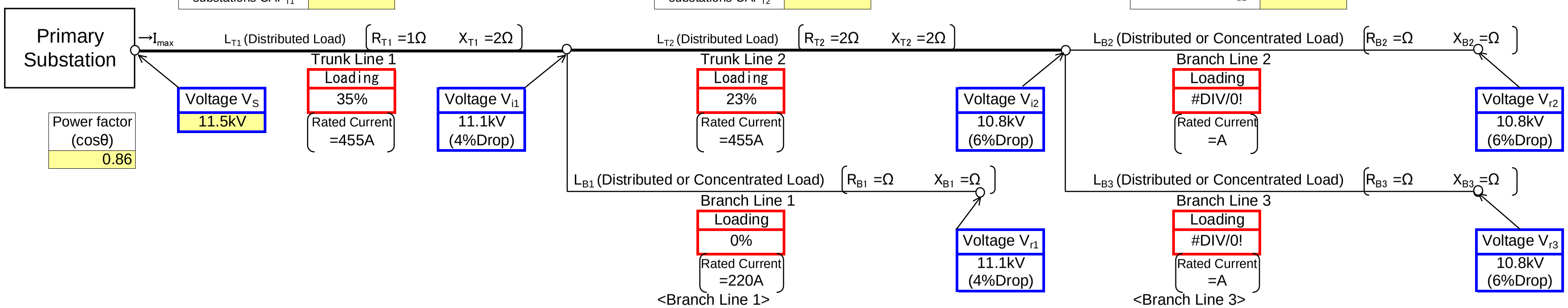
Load L_{T2}	107A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	5030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}
160A

Power factor (cosθ)
0.86



<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
120A

<Trank Line 1>

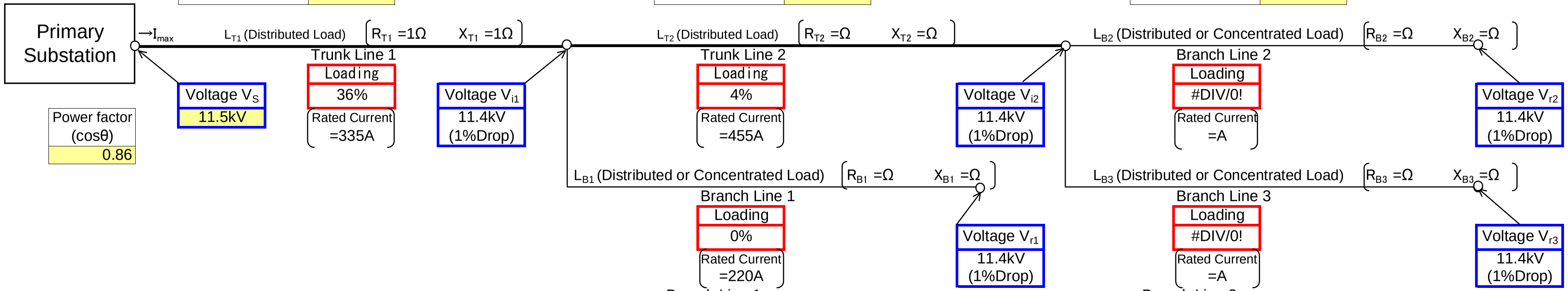
Load L_{T1}	108A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1845kVA	

<Trank Line 2>

Load L_{T2}	12A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	200kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



Power factor (cosθ)
0.86

<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
330A

Power factor (cosθ)
0.86

<Trank Line 1>

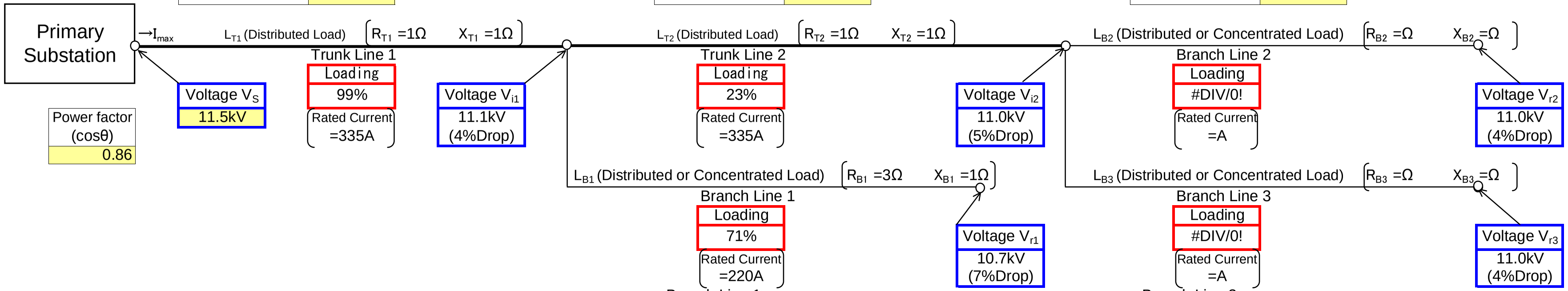
Load L_{T1}	96A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	78A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	156A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4070kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	PRASO

: Input data in colored cells

Type-3

Maximum Current I_{max}
54A

Power factor (cosθ)
0.86

Primary Substation

<Trank Line 1>

Load L_{T1}	20A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	5200kVA	

<Trank Line 2>

Load L_{T2}	7A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	37km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	3A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B2}	750kVA	

$\rightarrow I_{max}$

L_{T1} (Distributed Load) $(R_{T1}$ =Ω X_{T1} =1Ω)

Voltage V_S: 34.5kV

Trunk Line 1 — Loading 12% — Rated Current =455A

Voltage V_{i1}: 34.4kV (0%Drop)

L_{T2} (Distributed Load) $(R_{T2}$ =10Ω X_{T2} =13Ω)

Trunk Line 2 — Loading 3% — Rated Current =455A

Voltage V_{i2}: 34.2kV (1%Drop)

L_{B2} (Distributed or Concentrated Load) $(R_{B2}$ =2Ω X_{B2} =3Ω)

Branch Line 2 — Loading 1% — Rated Current =455A

Voltage V_{r2}: 34.2kV (1%Drop)

L_{B1} (Distributed or Concentrated Load) $(R_{B1}$ =15Ω X_{B1} =20Ω)

Branch Line 1 — Loading 4% — Rated Current =455A

Voltage V_{r1}: 34.0kV (1%Drop)

L_{B3} (Distributed or Concentrated Load) $(R_{B3}$ =2Ω X_{B3} =3Ω)

Branch Line 3 — Loading 1% — Rated Current =455A

Voltage V_{r3}: 34.2kV (1%Drop)

<Branch Line 1>

Load L_{B1}	20A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	56km	
Total Transformer Capacity of secondary substations CAP_{B1}	5350kVA	

<Branch Line 3>

Load L_{B3}	4A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	7km	
Total Transformer Capacity of secondary substations CAP_{B3}	1050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	PRASO

: Input data in colored cells

Type-3

Maximum Current I_{max}	
57A	

Power factor (cosθ)	
0.86	

<Trank Line 1>

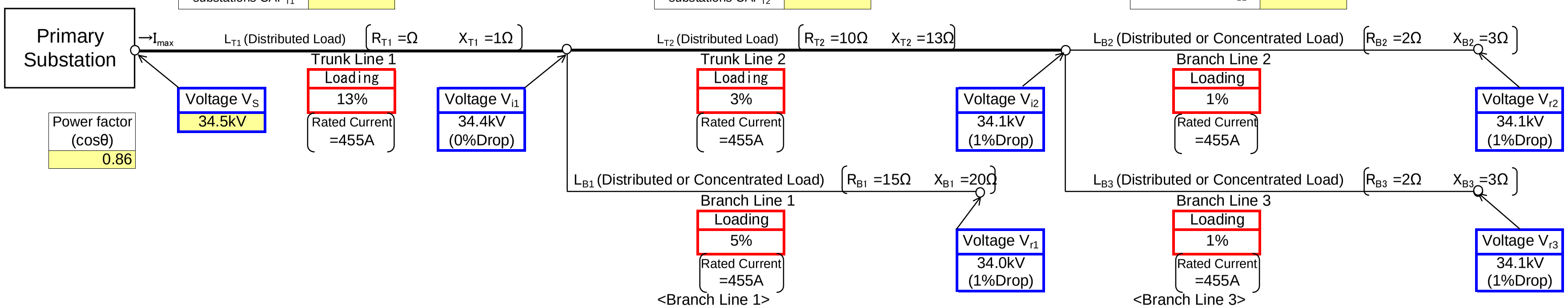
Load L_{T1}	21A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	5200kVA	

<Trank Line 2>

Load L_{T2}	8A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	37km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	3A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B2}	750kVA	



<Branch Line 1>

Load L_{B1}	21A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	56km	
Total Transformer Capacity of secondary substations CAP_{B1}	5350kVA	

<Branch Line 3>

Load L_{B3}	4A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	7km	
Total Transformer Capacity of secondary substations CAP_{B3}	1050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	PRASO

: Input data in colored cells

Type-3

Maximum Current I_{max}	
	60A

Power factor (cosθ)	
	0.86

<Trank Line 1>

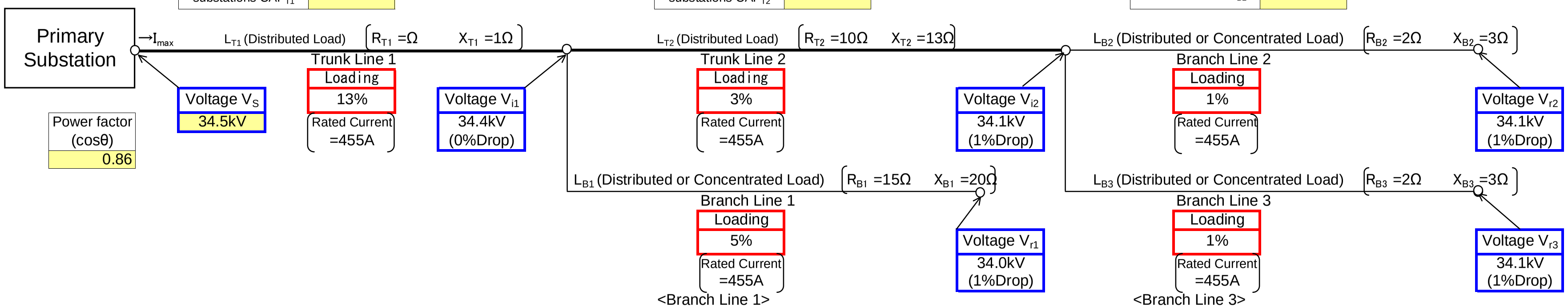
Load L_{T1}	22A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	5200kVA	

<Trank Line 2>

Load L_{T2}	8A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	37km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	3A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B2}	750kVA	



<Branch Line 1>

Load L_{B1}	23A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	56km	
Total Transformer Capacity of secondary substations CAP_{B1}	5350kVA	

<Branch Line 3>

Load L_{B3}	4A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	7km	
Total Transformer Capacity of secondary substations CAP_{B3}	1050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3} : Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3} : Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3} : Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	PRASO

: Input data in colored cells

Type-3

Maximum Current I_{max}
64A

Power factor (cosθ)
0.86

<Trank Line 1>

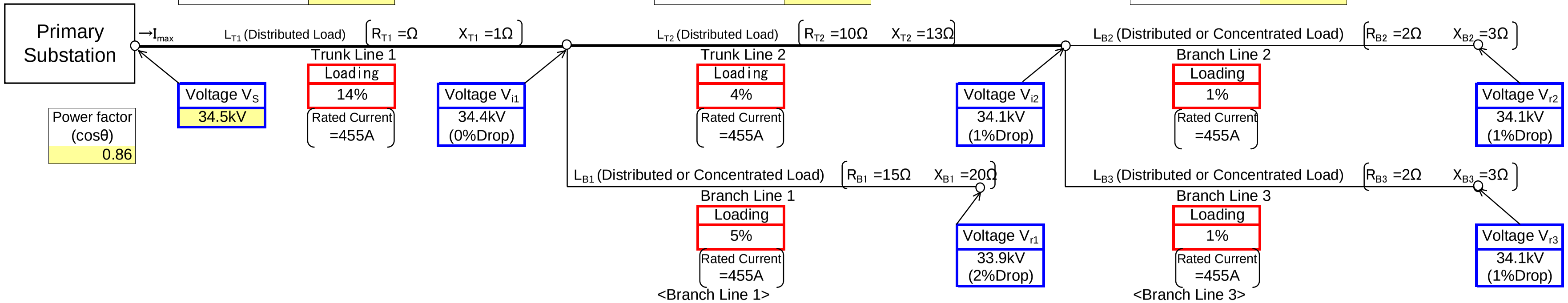
Load L_{T1}	23A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	5200kVA	

<Trank Line 2>

Load L_{T2}	9A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	37km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	3A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B2}	750kVA	



<Branch Line 1>

Load L_{B1}	24A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	56km	
Total Transformer Capacity of secondary substations CAP_{B1}	5350kVA	

<Branch Line 3>

Load L_{B3}	5A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	7km	
Total Transformer Capacity of secondary substations CAP_{B3}	1050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	PRASO

: Input data in colored cells

Type-3

Maximum Current I_{max}
68A

<Trank Line 1>

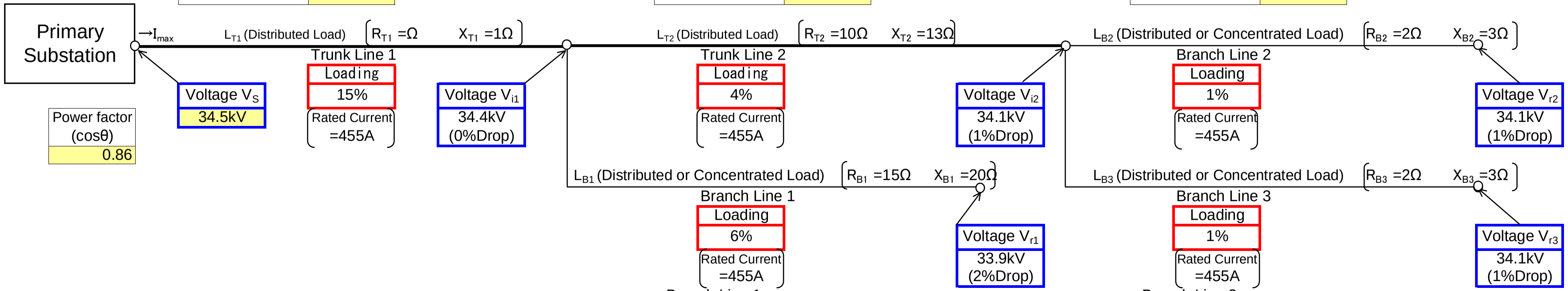
Load L_{T1}	25A
Line Type	AAC120mm2 No.7
Line Legth Len_{T1}	2km
Type of Distributed Load	Equality
Total Transformer Capacity of secondary substations CAP_{T1}	5200kVA

<Trank Line 2>

Load L_{T2}	9A
Line Type	AAC120mm2 No.7
Line Legth Len_{T2}	37km
Type of Distributed Load	Equality
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA

<Branch Line 2>

Load L_{B2}	4A
Line Type	AAC120mm2 No.7
Type of Load	Equality
Line Length Len_{B1}	8km
Total Transformer Capacity of secondary substations CAP_{B2}	750kVA



Power factor (cosθ)
0.86

<Branch Line 1>

Load L_{B1}	26A
Line Type	AAC120mm2 No.7
Type of Load	Equality
Line Length Len_{B1}	56km
Total Transformer Capacity of secondary substations CAP_{B1}	5350kVA

<Branch Line 3>

Load L_{B3}	5A
Line Type	AAC120mm2 No.7
Type of Load	Equality
Line Length Len_{B3}	7km
Total Transformer Capacity of secondary substations CAP_{B3}	1050kVA

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	PRASO

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	26A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	5200kVA	

<Trank Line 2>

Load L_{T2}	10A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	37km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	4A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B2}	750kVA	

Maximum Current I_{max}	72A
Power factor (cosθ)	0.86

Primary Substation

→I_{max}

Voltage V_s: 34.5kV

L_{T1} (Distributed Load) (R_{T1} =Ω X_{T1} =1Ω)

Trunk Line 1 — Loading 16% — Rated Current =455A

Voltage V_{i1}: 34.4kV (0%Drop)

L_{T2} (Distributed Load) (R_{T2} =10Ω X_{T2} =13Ω)

Trunk Line 2 — Loading 4% — Rated Current =455A

Voltage V_{i2}: 34.1kV (1%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =2Ω X_{B2} =3Ω)

Branch Line 2 — Loading 1% — Rated Current =455A

Voltage V_{r2}: 34.0kV (1%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =15Ω X_{B1} =20Ω)

Branch Line 1 — Loading 6% — Rated Current =455A

Voltage V_{r1}: 33.9kV (2%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =2Ω X_{B3} =3Ω)

Branch Line 3 — Loading 1% — Rated Current =455A

Voltage V_{r3}: 34.0kV (1%Drop)

<Branch Line 1>

Load L_{B1}	27A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	56km	
Total Transformer Capacity of secondary substations CAP_{B1}	5350kVA	

<Branch Line 3>

Load L_{B3}	5A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	7km	
Total Transformer Capacity of secondary substations CAP_{B3}	1050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	PRASO

: Input data in colored cells

Type-3

Maximum Current I_{max}
76A

Power factor (cosθ)
0.86

<Trank Line 1>

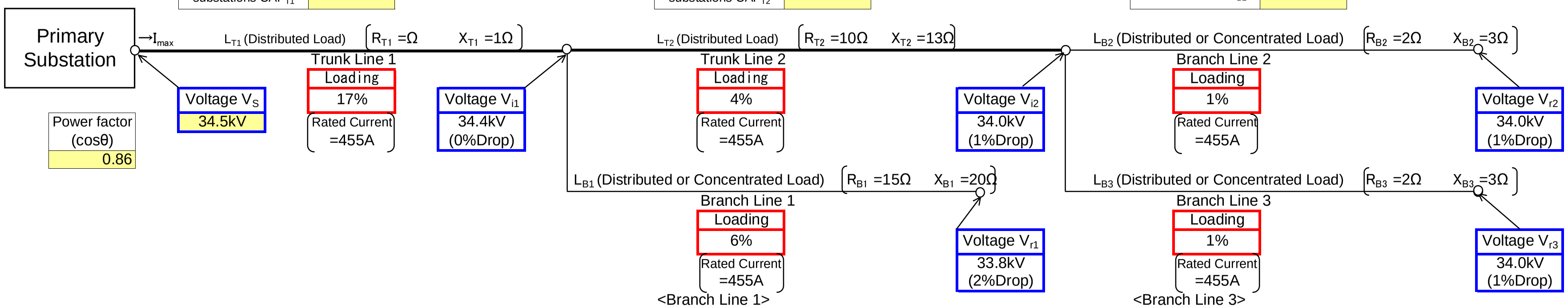
Load L_{T1}	28A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	5200kVA	

<Trank Line 2>

Load L_{T2}	10A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	37km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	4A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B2}	750kVA	



<Branch Line 1>

Load L_{B1}	29A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	56km	
Total Transformer Capacity of secondary substations CAP_{B1}	5350kVA	

<Branch Line 3>

Load L_{B3}	6A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	7km	
Total Transformer Capacity of secondary substations CAP_{B3}	1050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	PRASO

: Input data in colored cells

Type-3

Maximum Current I_{max}
80A

Power factor (cosθ)
0.86

<Trank Line 1>

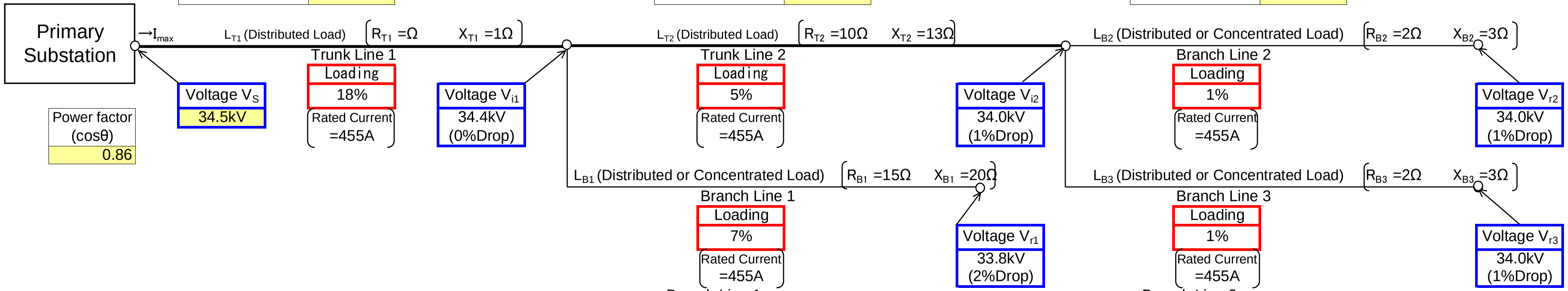
Load L_{T1}	29A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	5200kVA	

<Trank Line 2>

Load L_{T2}	11A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	37km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	4A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B2}	750kVA	



<Branch Line 1>

Load L_{B1}	30A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	56km	
Total Transformer Capacity of secondary substations CAP_{B1}	5350kVA	

<Branch Line 3>

Load L_{B3}	6A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	7km	
Total Transformer Capacity of secondary substations CAP_{B3}	1050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	PRASO

: Input data in colored cells

Type-3

Maximum Current I_{max}	
85A	

Power factor (cosθ)	
0.86	

<Trank Line 1>

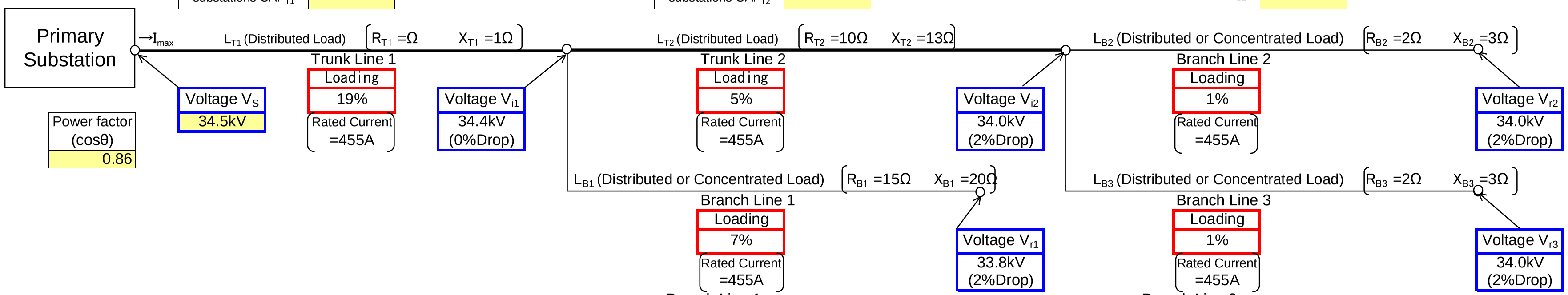
Load L_{T1}	31A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	5200kVA	

<Trank Line 2>

Load L_{T2}	11A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	37km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	4A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B2}	750kVA	



<Branch Line 1>

Load L_{B1}	32A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	56km	
Total Transformer Capacity of secondary substations CAP_{B1}	5350kVA	

<Branch Line 3>

Load L_{B3}	6A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	7km	
Total Transformer Capacity of secondary substations CAP_{B3}	1050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	PRASO

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	33A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	5200kVA	

<Trank Line 2>

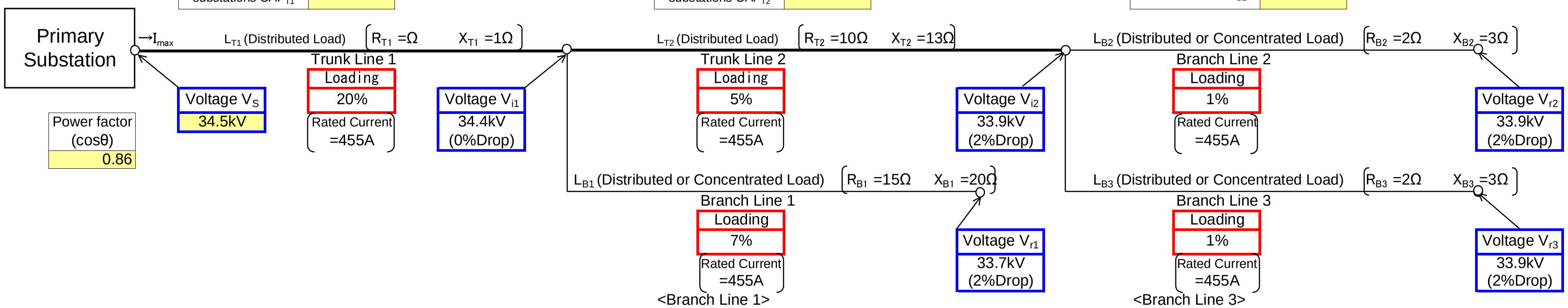
Load L_{T2}	12A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	37km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	5A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B2}	750kVA	

Maximum Current I_{max}
90A

Power factor (cosθ)
0.86



<Branch Line 1>

Load L_{B1}	34A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	56km	
Total Transformer Capacity of secondary substations CAP_{B1}	5350kVA	

<Branch Line 3>

Load L_{B3}	7A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	7km	
Total Transformer Capacity of secondary substations CAP_{B3}	1050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	PRASO

: Input data in colored cells

Type-3

Maximum Current I_{max}
95A

Power factor (cosθ)
0.86

<Trank Line 1>

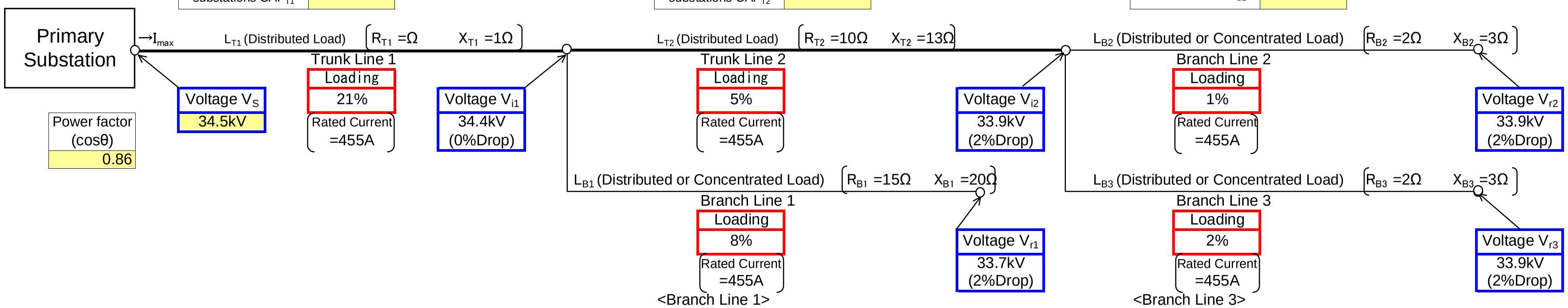
Load L_{T1}	35A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	5200kVA	

<Trank Line 2>

Load L_{T2}	13A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	37km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1900kVA	

<Branch Line 2>

Load L_{B2}	5A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B2}	750kVA	



<Branch Line 1>

Load L_{B1}	36A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	56km	
Total Transformer Capacity of secondary substations CAP_{B1}	5350kVA	

<Branch Line 3>

Load L_{B3}	7A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	7km	
Total Transformer Capacity of secondary substations CAP_{B3}	1050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage
V_{i1} : Interim Voltage
V_{i2} : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
V_{r3} : Received Voltage

I_{max} : Maximum Current
L_{T1} : Load (Trunk line 1)
L_{T2} : Load (Trunk line 2)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
L_{B3} : Load (Branch Line 3)

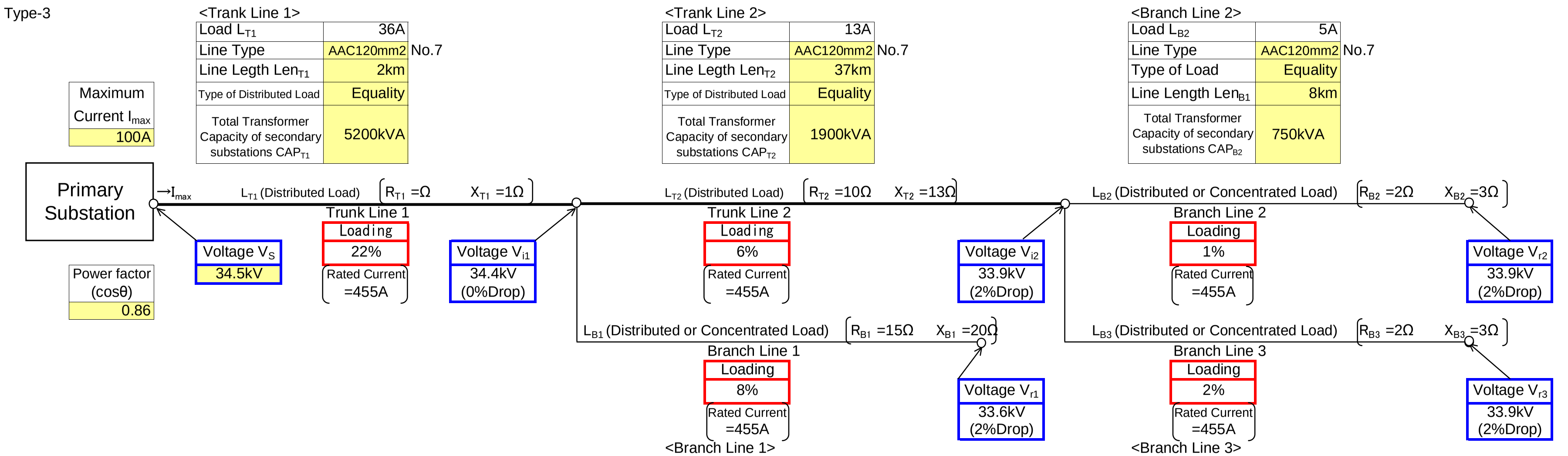
$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
$CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3}$: Total Transformer Capacity of secondary substations
cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	PRASO

: Input data in colored cells

Type-3



<Branch Line 1>

Load L_{B1}	38A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	56km	
Total Transformer Capacity of secondary substations CAP_{B1}	5350kVA	

<Branch Line 3>

Load L_{B3}	7A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	7km	
Total Transformer Capacity of secondary substations CAP_{B3}	1050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	RIDGES

: Input data in colored cells

Type-3

Maximum Current I_{max}	120A
Power factor (cosθ)	0.86

<Trank Line 1>

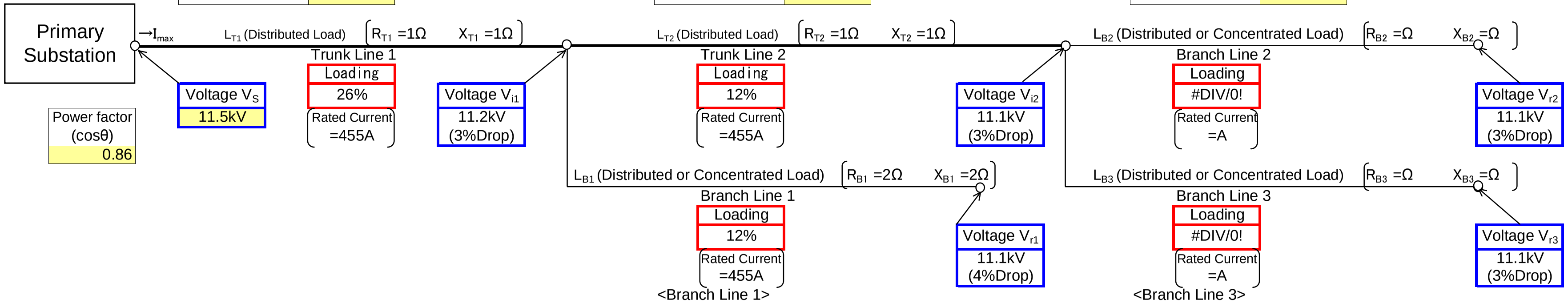
Load L_{T1}	14A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	200kVA	

<Trank Line 2>

Load L_{T2}	53A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	750kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	53A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	6km	
Total Transformer Capacity of secondary substations CAP_{B1}	750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	RIDGES

: Input data in colored cells

Type-3

Maximum Current I_{max}
127A

Power factor (cosθ)
0.86

<Trank Line 1>

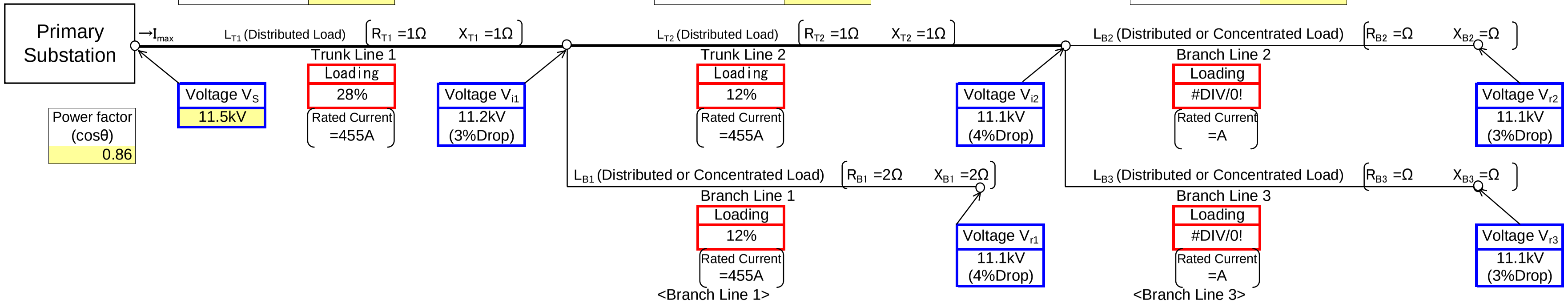
Load L_{T1}	15A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	200kVA	

<Trank Line 2>

Load L_{T2}	56A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	750kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	56A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	6km	
Total Transformer Capacity of secondary substations CAP_{B1}	750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	RIDGES

: Input data in colored cells

Type-3

Maximum Current I_{max}
134A

Power factor (cosθ)
0.86

<Trank Line 1>

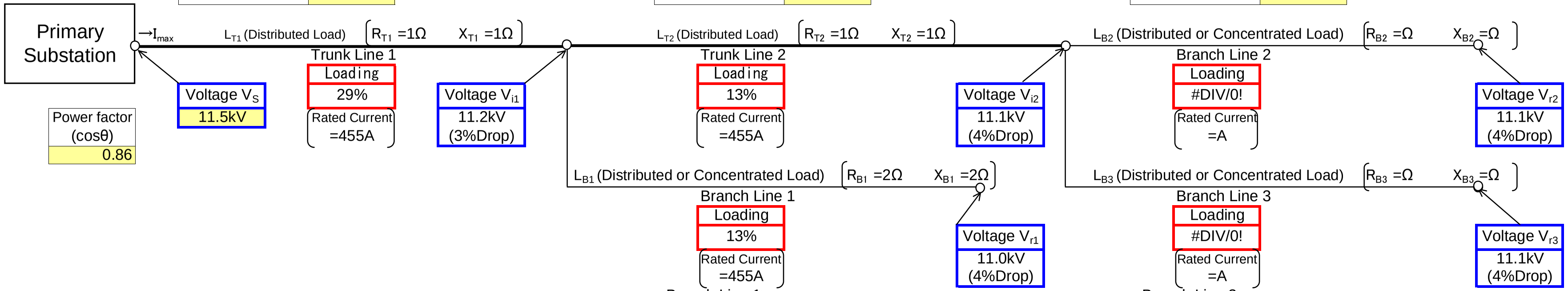
Load L_{T1}	16A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	200kVA	

<Trank Line 2>

Load L_{T2}	59A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	750kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	59A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	6km	
Total Transformer Capacity of secondary substations CAP_{B1}	750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	RIDGES

: Input data in colored cells

Type-3

Maximum Current I_{max}
142A

Power factor (cosθ)
0.86

<Trank Line 1>

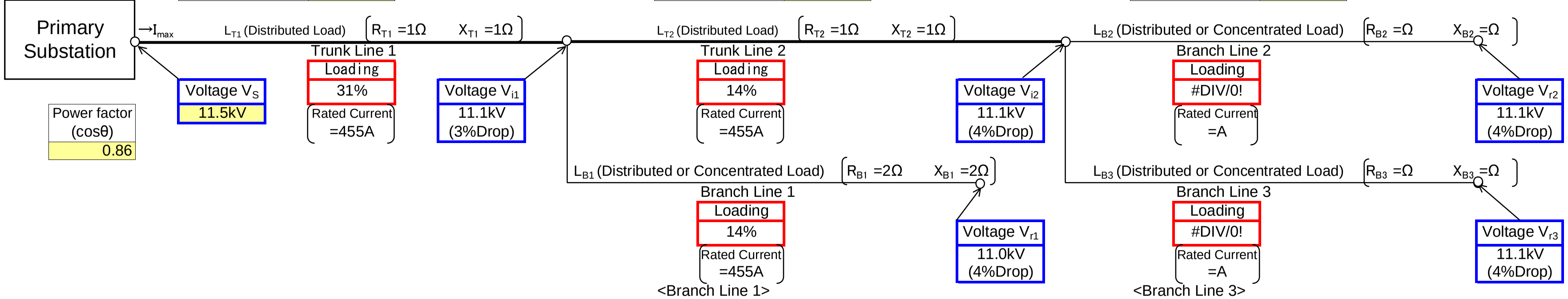
Load L_{T1}	17A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	200kVA	

<Trank Line 2>

Load L_{T2}	63A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	750kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	63A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	6km	
Total Transformer Capacity of secondary substations CAP_{B1}	750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	RIDGES

: Input data in colored cells

Type-3

Maximum Current I_{max}
150A

Power factor (cosθ)
0.86

<Trank Line 1>

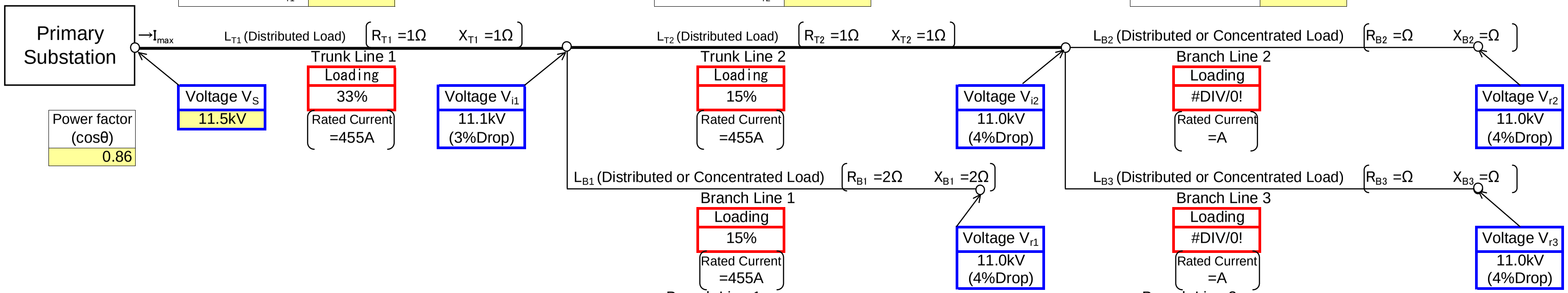
Load L_{T1}	18A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	200kVA	

<Trank Line 2>

Load L_{T2}	66A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	750kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	66A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	6km	
Total Transformer Capacity of secondary substations CAP_{B1}	750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	RIDGES

: Input data in colored cells

Type-3

Maximum Current I_{max}
159A

Power factor (cosθ)
0.86

<Trank Line 1>

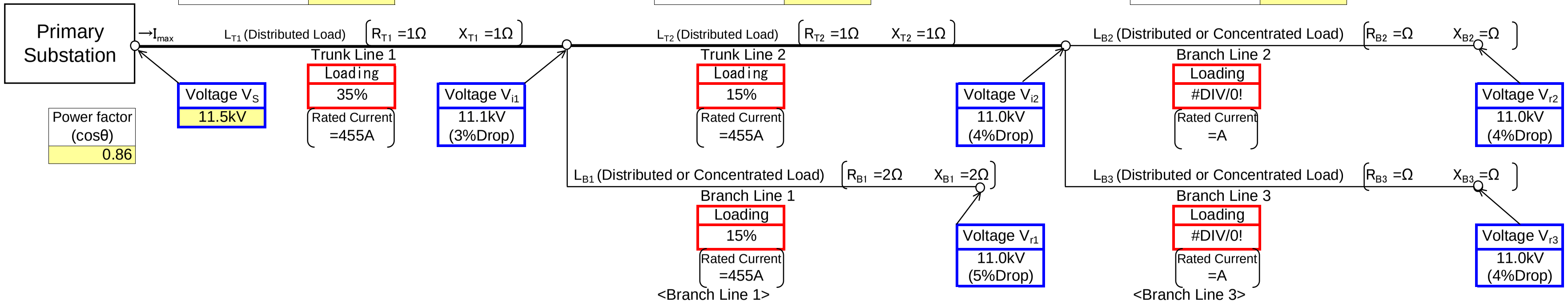
Load L_{T1}	19A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	200kVA	

<Trank Line 2>

Load L_{T2}	70A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	750kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	70A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	6km	
Total Transformer Capacity of secondary substations CAP_{B1}	750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	RIDGES

: Input data in colored cells

Type-3

Maximum Current I_{max}
168A

<Trank Line 1>

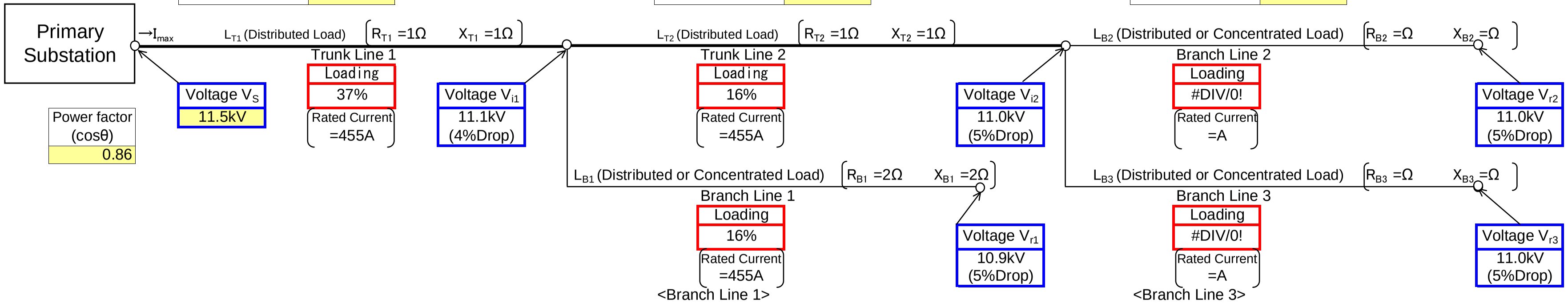
Load L_{T1}	20A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	200kVA	

<Trank Line 2>

Load L_{T2}	74A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	750kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



Power factor (cosθ)
0.86

<Branch Line 1>

Load L_{B1}	74A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	6km	
Total Transformer Capacity of secondary substations CAP_{B1}	750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	RIDGES

: Input data in colored cells

Type-3

Maximum Current I_{max}
178A

<Trank Line 1>

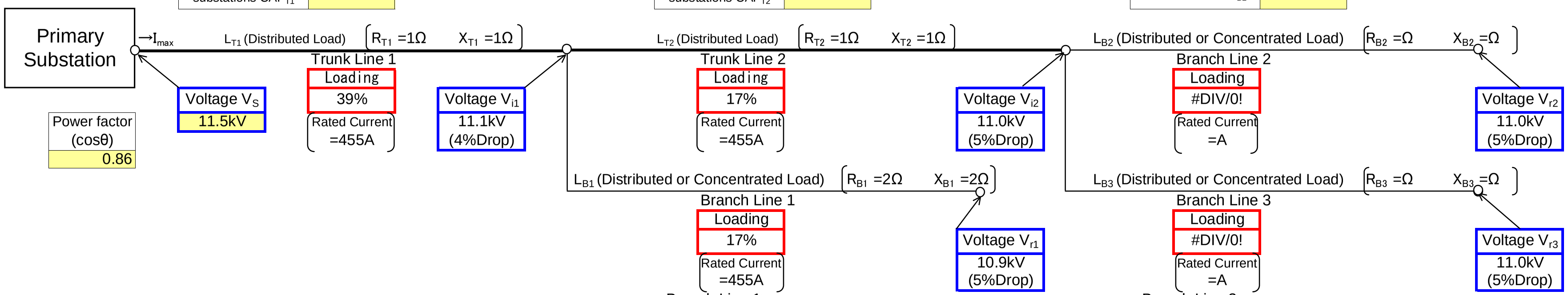
Load L_{T1}	21A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	200kVA	

<Trank Line 2>

Load L_{T2}	79A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	750kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	79A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	6km	
Total Transformer Capacity of secondary substations CAP_{B1}	750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	RIDGES

: Input data in colored cells

Type-3

Maximum Current I_{max}
188A

Power factor (cosθ)
0.86

<Trank Line 1>

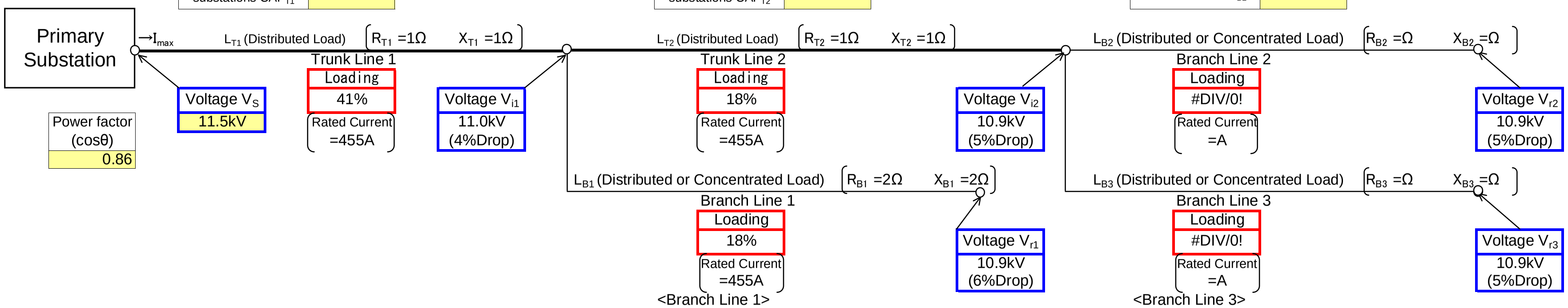
Load L_{T1}	22A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	200kVA	

<Trank Line 2>

Load L_{T2}	83A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	750kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	83A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	6km	
Total Transformer Capacity of secondary substations CAP_{B1}	750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	RIDGES

: Input data in colored cells

Type-3

Maximum Current I_{max}
199A

Power factor (cosθ)
0.86

Primary Substation → I_{max}

Voltage V_S: 11.5kV

<Trank Line 1>

Load L_{T1}	23A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	200kVA	

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)

Trunk Line 1 — Loading 44% (Rated Current =455A)

Voltage V_{i1}: 11.0kV (4%Drop)

<Trank Line 2>

Load L_{T2}	88A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	750kVA	

L_{T2} (Distributed Load) (R_{T2} =1Ω X_{T2} =1Ω)

Trunk Line 2 — Loading 19% (Rated Current =455A)

Voltage V_{i2}: 10.9kV (6%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2 — Loading #DIV/0! (Rated Current =A)

Voltage V_{r2}: 10.9kV (5%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =2Ω X_{B1} =2Ω)

Branch Line 1 — Loading 19% (Rated Current =455A)

Voltage V_{r1}: 10.8kV (6%Drop)

<Branch Line 1>

Load L_{B1}	88A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	6km	
Total Transformer Capacity of secondary substations CAP_{B1}	750kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 — Loading #DIV/0! (Rated Current =A)

Voltage V_{r3}: 10.9kV (5%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage
V_{i1} : Interim Voltage
V_{i2} : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
V_{r3} : Received Voltage

I_{max} : Maximum Current
L_{T1} : Load (Trunk line 1)
L_{T2} : Load (Trunk line 2)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
L_{B3} : Load (Branch Line 3)

$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
$CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3}$: Total Transformer Capacity of secondary substations
cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	RIDGES

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	25A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	200kVA	

<Trank Line 2>

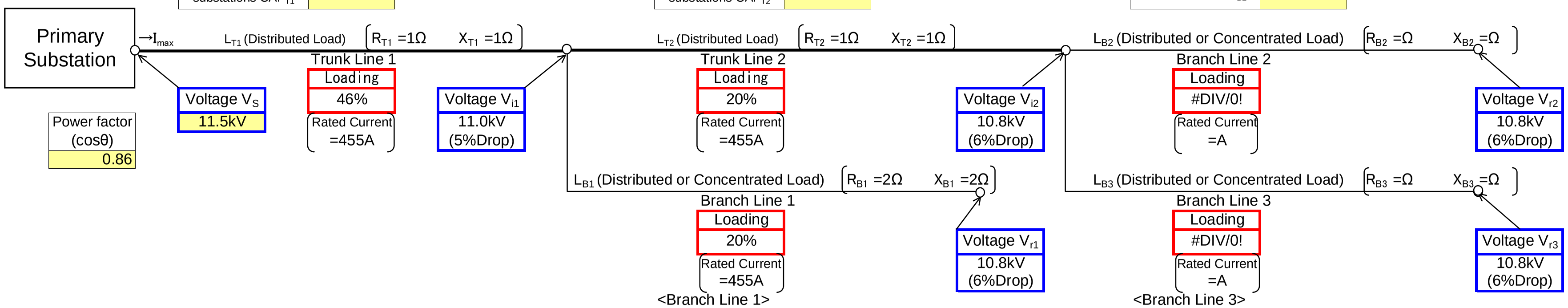
Load L_{T2}	93A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	750kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}	211A

Power factor (cosθ)	0.86



<Branch Line 1>

Load L_{B1}	93A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	6km	
Total Transformer Capacity of secondary substations CAP_{B1}	750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	RIDGES

: Input data in colored cells

Type-3

Maximum Current I_{max}	
223A	

<Trank Line 1>

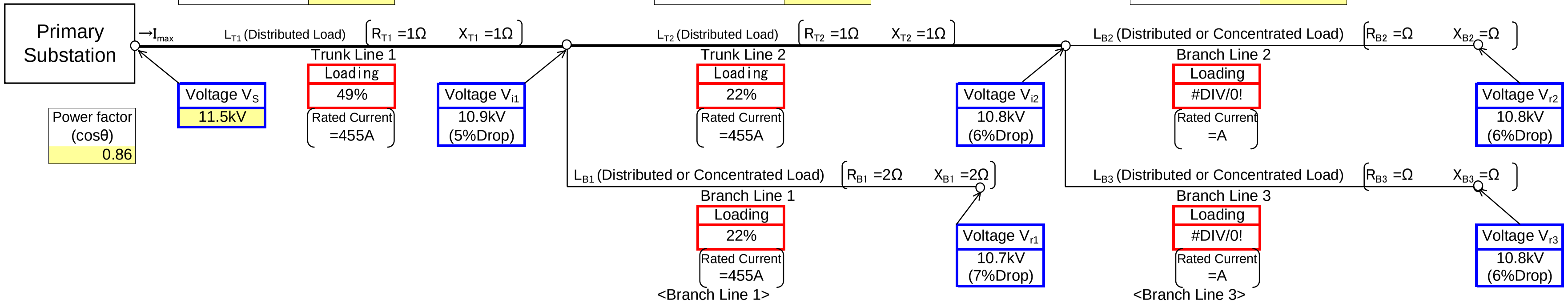
Load L_{T1}	26A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	200kVA	

<Trank Line 2>

Load L_{T2}	98A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	750kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	98A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	6km	
Total Transformer Capacity of secondary substations CAP_{B1}	750kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Primary Substation

Maximum Current I_{max}
47A

Power factor (cosθ)
0.86

Voltage V_s 11.5kV

<Trank Line 1>

Load L_{T1}	24A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	980kVA	

→I_{max} L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)

Trunk Line 1 Loading 10% (Rated Current =455A)

Voltage V_{i1} 11.4kV (1%Drop)

<Trank Line 2>

Load L_{T2}	23A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	950kVA	

L_{T2} (Distributed Load) (R_{T2} =2Ω X_{T2} =2Ω)

Trunk Line 2 Loading 5% (Rated Current =455A)

Voltage V_{i2} 11.4kV (1%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2 Loading #DIV/0! (Rated Current =A)

Voltage V_{r2} 11.4kV (1%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1 Loading #DIV/0! (Rated Current =A)

Voltage V_{r1} 11.4kV (1%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 Loading #DIV/0! (Rated Current =A)

Voltage V_{r3} 11.4kV (1%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1}/(CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2}/(CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1}/(CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2}/(CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3}/(CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}
50A

Power factor (cosθ)
0.86

<Trank Line 1>

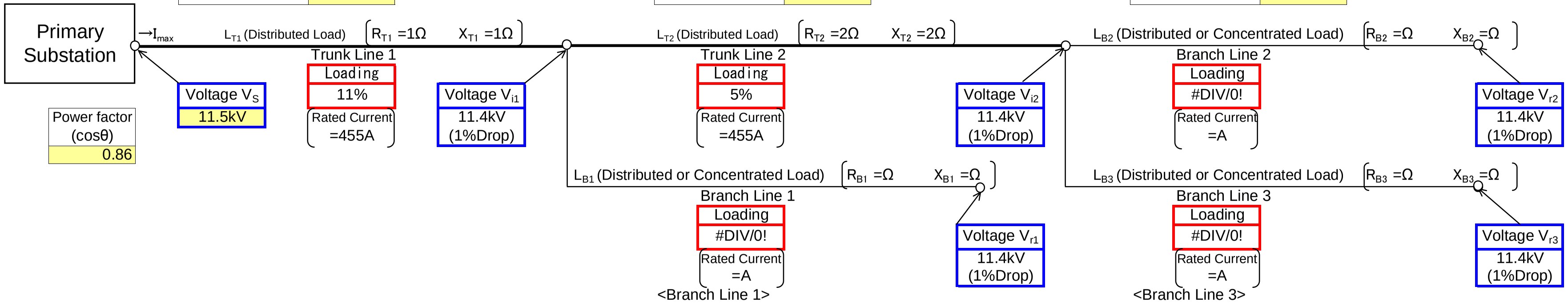
Load L_{T1}	25A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	980kVA	

<Trank Line 2>

Load L_{T2}	25A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	950kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	SALTPOND
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}
53A

Power factor (cosθ)
0.86

<Trank Line 1>

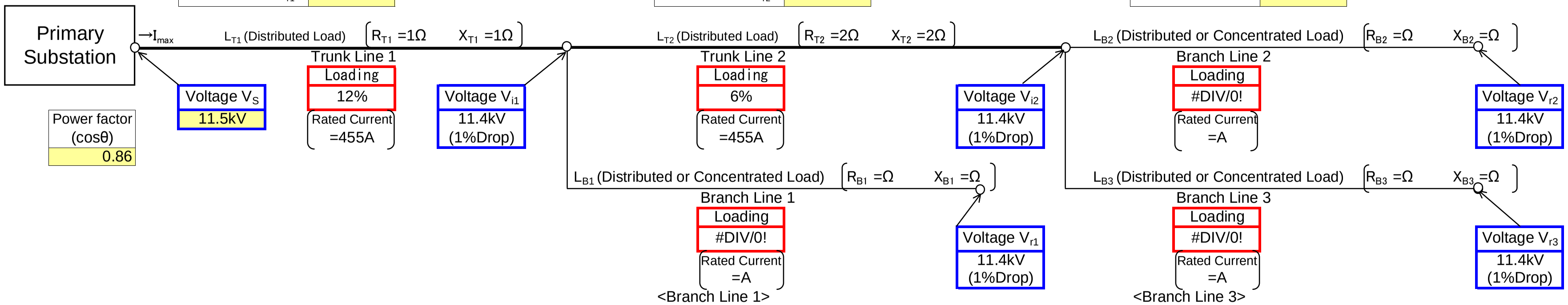
Load L_{T1}	27A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	980kVA	

<Trank Line 2>

Load L_{T2}	26A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	950kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}	56A
Power factor (cosθ)	0.86

<Trank Line 1>

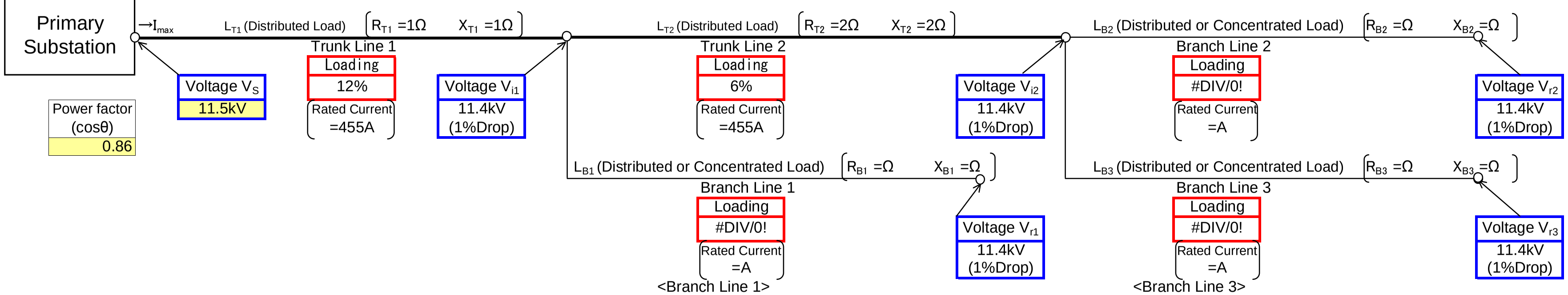
Load L_{T1}	28A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	980kVA	

<Trank Line 2>

Load L_{T2}	28A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	950kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}	59A
Power factor (cosθ)	0.86

<Trank Line 1>

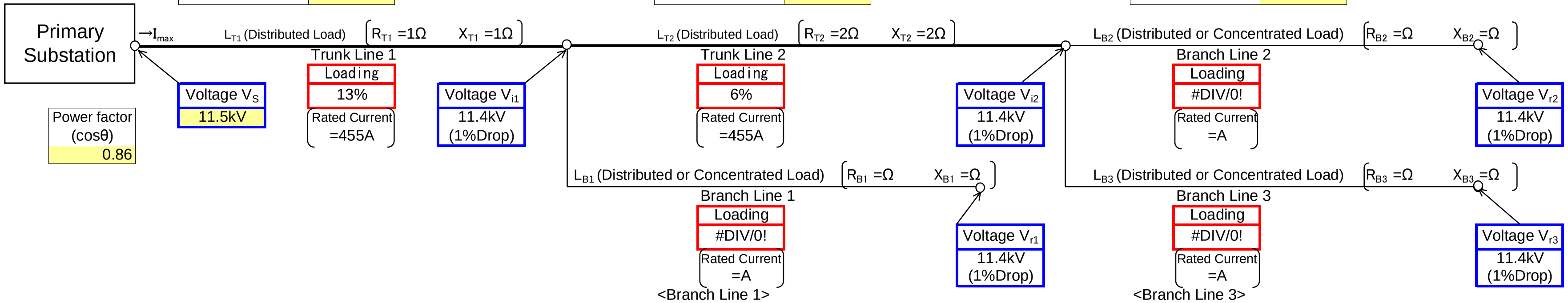
Load L_{T1}	30A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	980kVA	

<Trank Line 2>

Load L_{T2}	29A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	950kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}
62A

Power factor (cosθ)
0.86

<Trank Line 1>

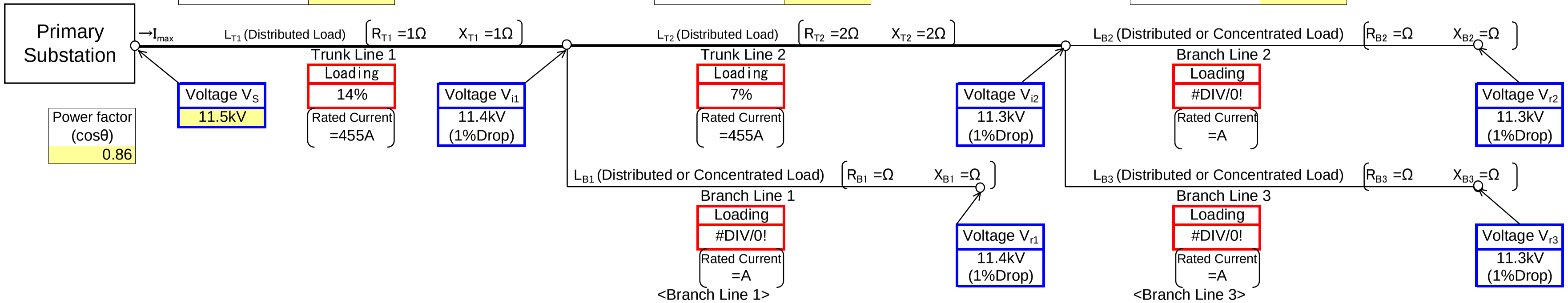
Load L_{T1}	31A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	980kVA	

<Trank Line 2>

Load L_{T2}	31A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	950kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}
66A

Power factor (cosθ)
0.86

<Trank Line 1>

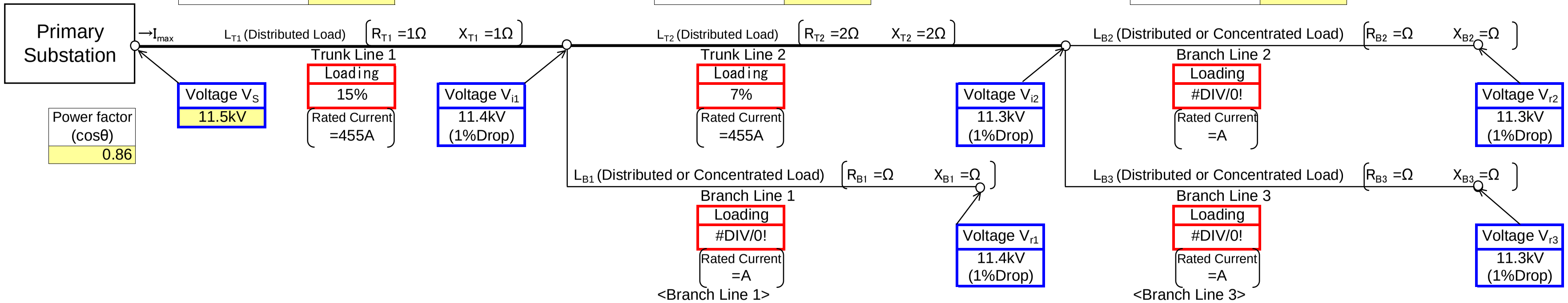
Load L_{T1}	34A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	980kVA	

<Trank Line 2>

Load L_{T2}	32A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	950kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}: 70A

Power factor (cosθ): 0.86

Primary Substation

Voltage V_S: 11.5kV

<Trank Line 1>

Load L_{T1}	36A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	980kVA	

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)

Trunk Line 1: Loading 15%, Rated Current =455A

Voltage V_{i1}: 11.4kV (1%Drop)

<Trank Line 2>

Load L_{T2}	34A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	950kVA	

L_{T2} (Distributed Load) (R_{T2} =2Ω X_{T2} =2Ω)

Trunk Line 2: Loading 8%, Rated Current =455A

Voltage V_{i2}: 11.3kV (1%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2: Loading #DIV/0!, Rated Current =A

Voltage V_{r2}: 11.3kV (1%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1: Loading #DIV/0!, Rated Current =A

Voltage V_{r1}: 11.4kV (1%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!, Rated Current =A

Voltage V_{r3}: 11.3kV (1%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}	74A
Power factor (cosθ)	0.86

Primary Substation

Voltage V_s: 11.5kV

<Trank Line 1>

Load L_{T1}	38A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	980kVA	

$\rightarrow I_{max}$ L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)

Trunk Line 1 — Loading 16% — Rated Current =455A

Voltage V_{i1}: 11.4kV (1%Drop)

<Trank Line 2>

Load L_{T2}	36A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	950kVA	

L_{T2} (Distributed Load) (R_{T2} =2Ω X_{T2} =2Ω)

Trunk Line 2 — Loading 8% — Rated Current =455A

Voltage V_{i2}: 11.3kV (2%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2 — Loading #DIV/0! — Rated Current =A

Voltage V_{r2}: 11.3kV (2%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1 — Loading #DIV/0! — Rated Current =A

Voltage V_{r1}: 11.4kV (1%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 — Loading #DIV/0! — Rated Current =A

Voltage V_{r3}: 11.3kV (2%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

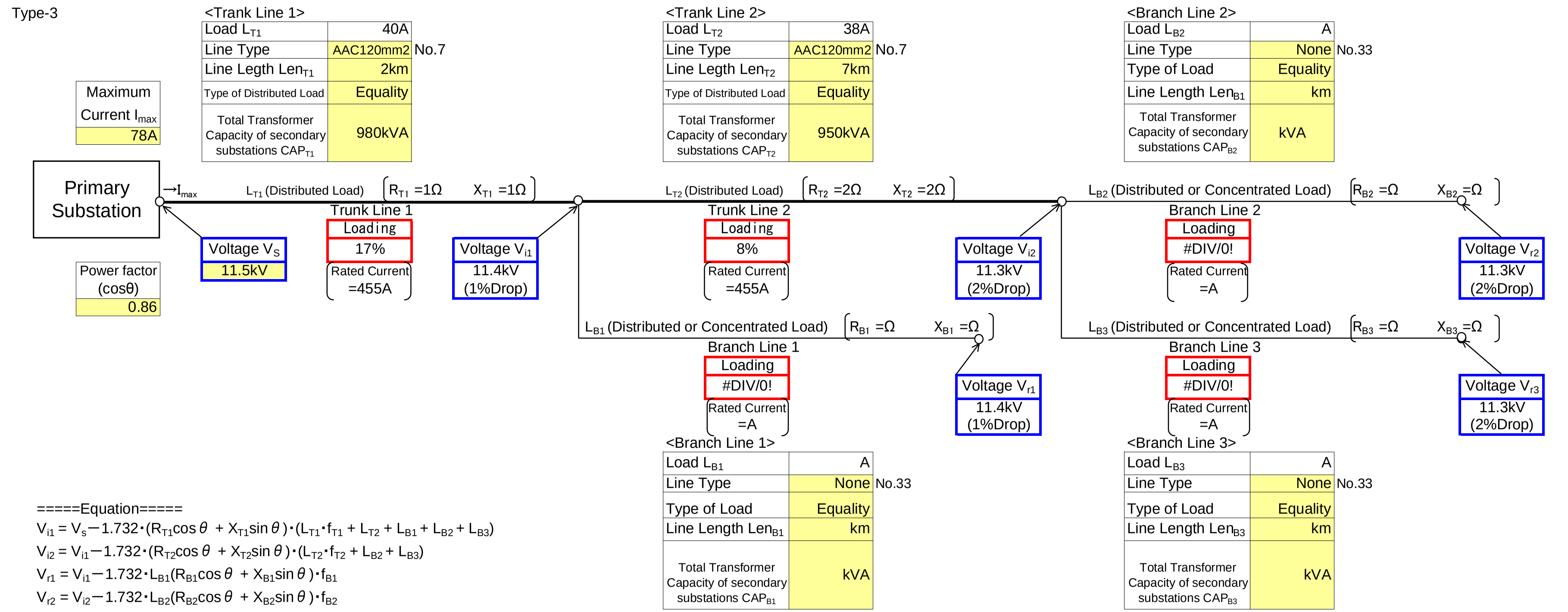
$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	SALTPOND

: Input data in colored cells



=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}
83A

Power factor (cosθ)
0.86

<Trank Line 1>

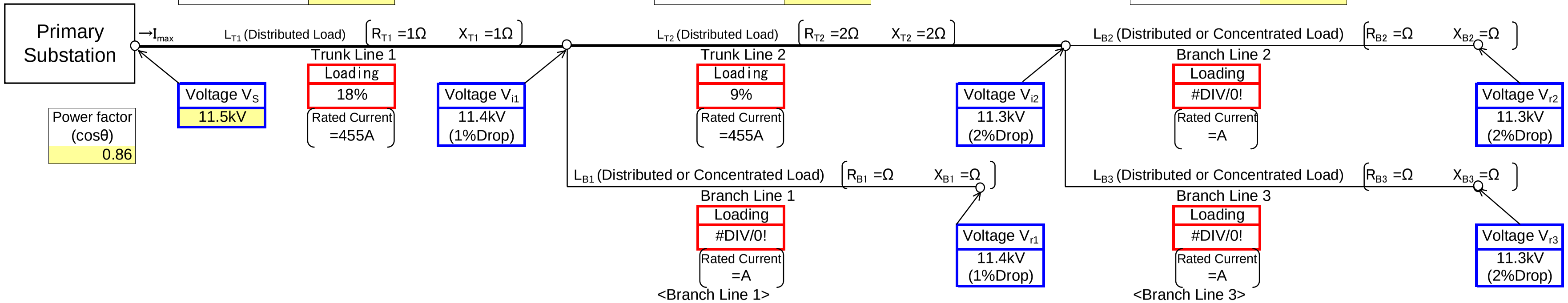
Load L_{T1}	42A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	980kVA	

<Trank Line 2>

Load L_{T2}	41A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	950kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	SALTPOND
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}
87A

Power factor (cosθ)
0.86

<Trank Line 1>

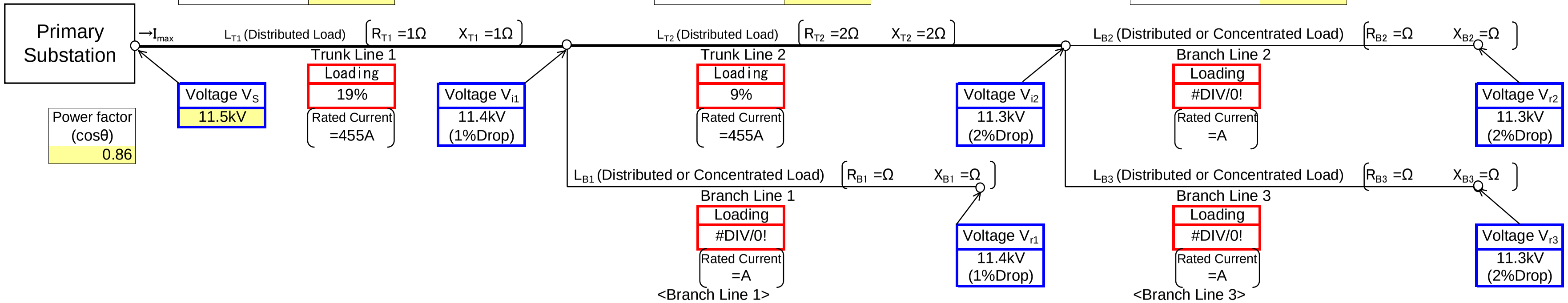
Load L_{T1}	44A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	2km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	980kVA	

<Trank Line 2>

Load L_{T2}	43A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	950kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage
V_{i1} : Interim Voltage
V_{i2} : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
V_{r3} : Received Voltage

I_{max} : Maximum Current
L_{T1} : Load (Trunk line 1)
L_{T2} : Load (Trunk line 2)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
L_{B3} : Load (Branch Line 3)

$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
$CAP_{T1}, CAP_{T2}, CAP_{B1}$, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}
86A

<Trank Line 1>

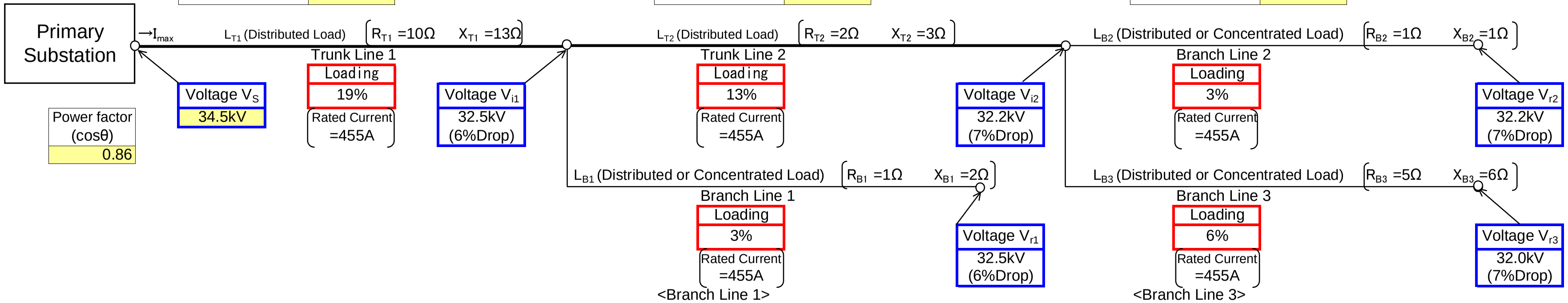
Load L_{T1}	17A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	35km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1300kVA	

<Trank Line 2>

Load L_{T2}	18A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1400kVA	

<Branch Line 2>

Load L_{B2}	13A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	3km	
Total Transformer Capacity of secondary substations CAP_{B2}	980kVA	



<Branch Line 1>

Load L_{B1}	12A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	5km	
Total Transformer Capacity of secondary substations CAP_{B1}	950kVA	

<Branch Line 3>

Load L_{B3}	26A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	18km	
Total Transformer Capacity of secondary substations CAP_{B3}	2050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

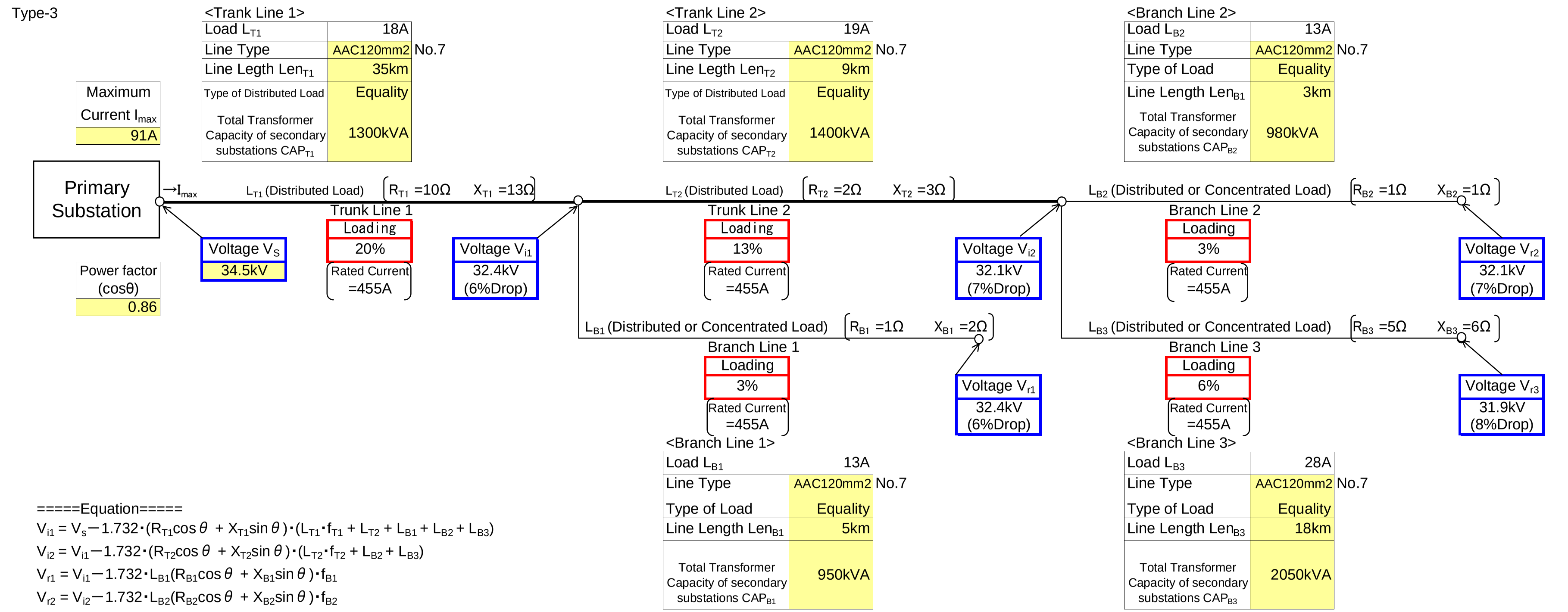
$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	SALTPOND

: Input data in colored cells



=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}
96A

Power factor (cosθ)
0.86

<Trank Line 1>

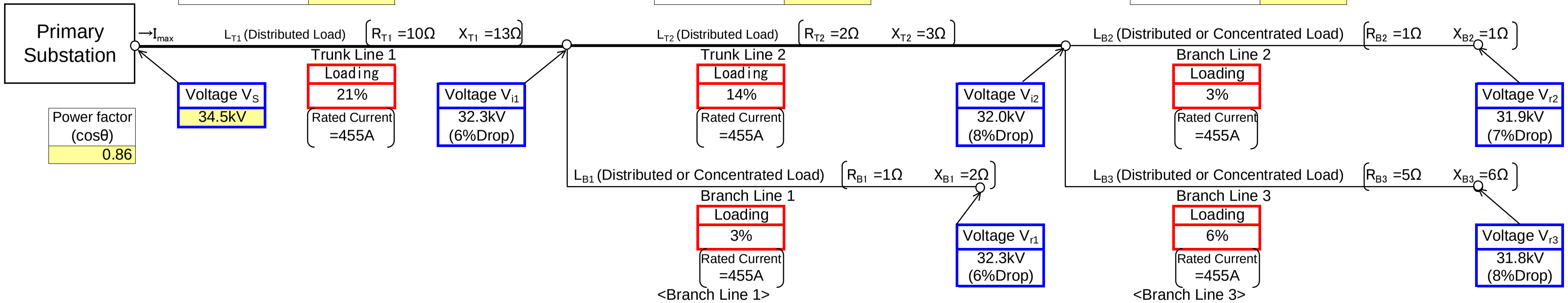
Load L_{T1}	19A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	35km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1300kVA	

<Trank Line 2>

Load L_{T2}	20A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1400kVA	

<Branch Line 2>

Load L_{B2}	14A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	3km	
Total Transformer Capacity of secondary substations CAP_{B2}	980kVA	



<Branch Line 1>

Load L_{B1}	14A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	5km	
Total Transformer Capacity of secondary substations CAP_{B1}	950kVA	

<Branch Line 3>

Load L_{B3}	29A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	18km	
Total Transformer Capacity of secondary substations CAP_{B3}	2050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}
102A

Power factor (cosθ)
0.86

<Trank Line 1>

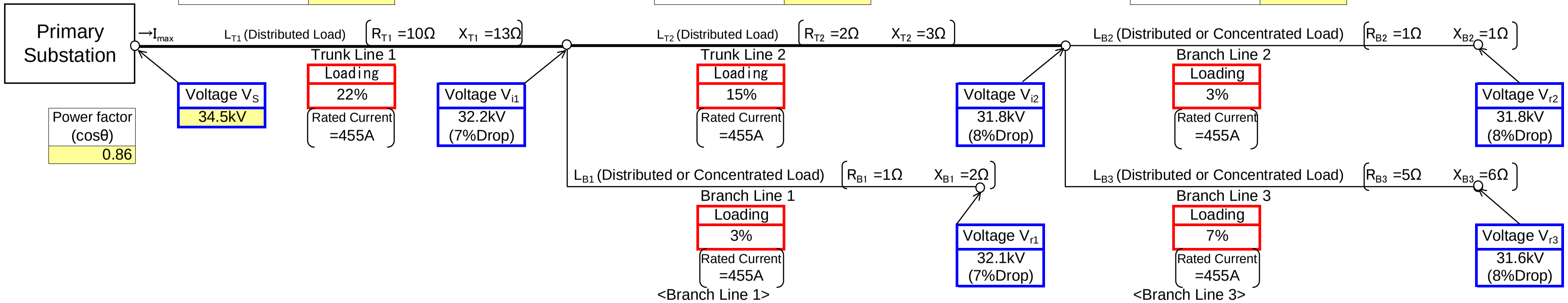
Load L_{T1}	20A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	35km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1300kVA	

<Trank Line 2>

Load L_{T2}	21A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1400kVA	

<Branch Line 2>

Load L_{B2}	15A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	3km	
Total Transformer Capacity of secondary substations CAP_{B2}	980kVA	



<Branch Line 1>

Load L_{B1}	15A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	5km	
Total Transformer Capacity of secondary substations CAP_{B1}	950kVA	

<Branch Line 3>

Load L_{B3}	31A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	18km	
Total Transformer Capacity of secondary substations CAP_{B3}	2050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage
V_{i1} : Interim Voltage
V_{i2} : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
V_{r3} : Received Voltage

I_{max} : Maximum Current
L_{T1} : Load (Trunk line 1)
L_{T2} : Load (Trunk line 2)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
L_{B3} : Load (Branch Line 3)

$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
$CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3}$: Total Transformer Capacity of secondary substations
cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}	108A
Power factor (cosθ)	0.86

Primary Substation

Voltage V_S: 34.5kV

$\rightarrow I_{max}$

<Trank Line 1>

Load L_{T1}	21A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	35km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1300kVA	

L_{T1} (Distributed Load) (R_{T1} =10Ω X_{T1} =13Ω)

Trunk Line 1: Loading 24%, Rated Current =455A

Voltage V_{i1}: 32.0kV (7%Drop)

<Trank Line 2>

Load L_{T2}	23A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1400kVA	

L_{T2} (Distributed Load) (R_{T2} =2Ω X_{T2} =3Ω)

Trunk Line 2: Loading 16%, Rated Current =455A

Voltage V_{i2}: 31.6kV (9%Drop)

<Branch Line 2>

Load L_{B2}	16A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	3km	
Total Transformer Capacity of secondary substations CAP_{B2}	980kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =1Ω X_{B2} =1Ω)

Branch Line 2: Loading 3%, Rated Current =455A

Voltage V_{r2}: 31.6kV (8%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =1Ω X_{B1} =2Ω)

Branch Line 1: Loading 3%, Rated Current =455A

Voltage V_{r1}: 32.0kV (7%Drop)

<Branch Line 1>

Load L_{B1}	15A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	5km	
Total Transformer Capacity of secondary substations CAP_{B1}	950kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =5Ω X_{B3} =6Ω)

Branch Line 3: Loading 7%, Rated Current =455A

Voltage V_{r3}: 31.4kV (9%Drop)

<Branch Line 3>

Load L_{B3}	33A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	18km	
Total Transformer Capacity of secondary substations CAP_{B3}	2050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}
114A

Power factor (cosθ)
0.86

<Trank Line 1>

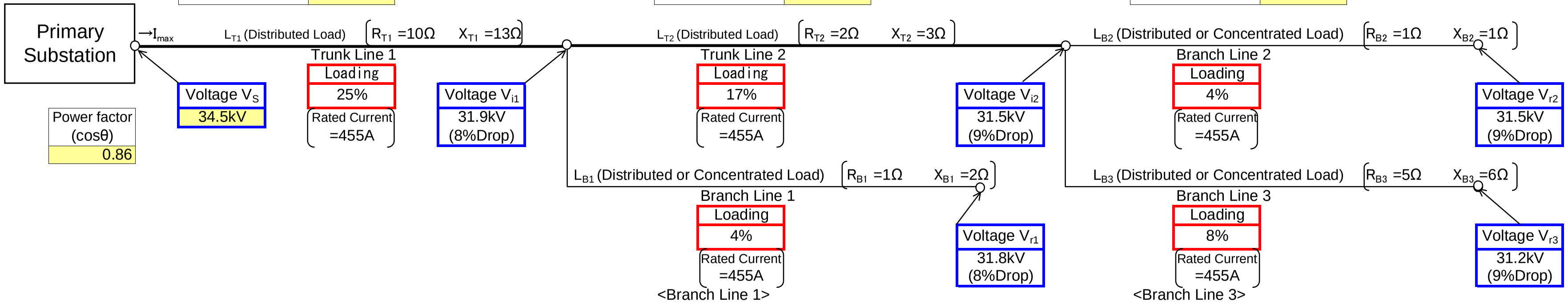
Load L_{T1}	22A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	35km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1300kVA	

<Trank Line 2>

Load L_{T2}	24A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1400kVA	

<Branch Line 2>

Load L_{B2}	17A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	3km	
Total Transformer Capacity of secondary substations CAP_{B2}	980kVA	



<Branch Line 1>

Load L_{B1}	16A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	5km	
Total Transformer Capacity of secondary substations CAP_{B1}	950kVA	

<Branch Line 3>

Load L_{B3}	35A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	18km	
Total Transformer Capacity of secondary substations CAP_{B3}	2050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

- V_s : Supply Voltage
- V_{i1} : Interim Voltage
- V_{i2} : Interim Voltage
- V_{r1} : Received Voltage
- V_{r2} : Received Voltage
- V_{r3} : Received Voltage
- I_{max} : Maximum Current
- L_{T1} : Load (Trunk line 1)
- L_{T2} : Load (Trunk line 2)
- L_{B1} : Load (Branch Line 1)
- L_{B2} : Load (Branch Line 2)
- L_{B3} : Load (Branch Line 3)
- R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3} : Resistance
- X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3} : Reactance
- f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3} : Dispersal Load Factor
- CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
- cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}
121A

Power factor (cosθ)
0.86

<Trank Line 1>

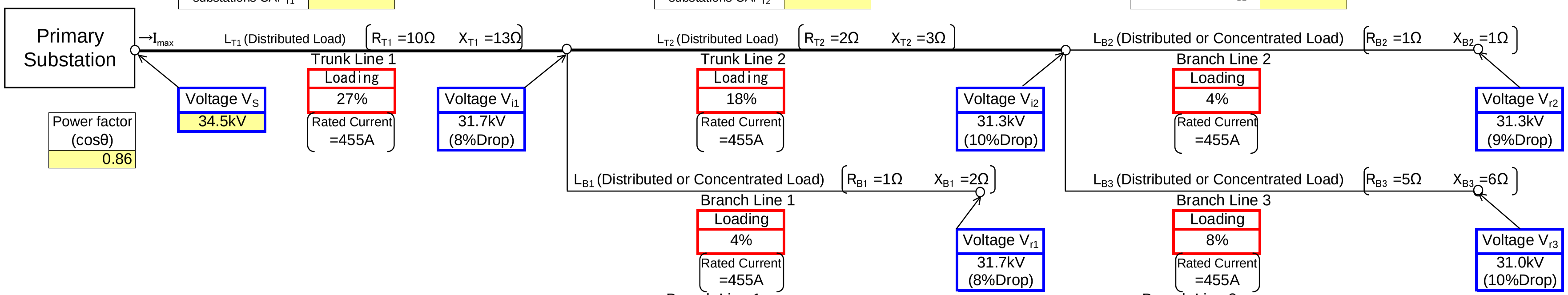
Load L_{T1}	24A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	35km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1300kVA	

<Trank Line 2>

Load L_{T2}	25A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1400kVA	

<Branch Line 2>

Load L_{B2}	18A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	3km	
Total Transformer Capacity of secondary substations CAP_{B2}	980kVA	



<Branch Line 1>

Load L_{B1}	17A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	5km	
Total Transformer Capacity of secondary substations CAP_{B1}	950kVA	

<Branch Line 3>

Load L_{B3}	37A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	18km	
Total Transformer Capacity of secondary substations CAP_{B3}	2050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	SALTPOND

(Yellow) : Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	25A
Line Type	AAC120mm2 No.7
Line Legth Len_{T1}	35km
Type of Distributed Load	Equality
Total Transformer Capacity of secondary substations CAP_{T1}	1300kVA

<Trank Line 2>

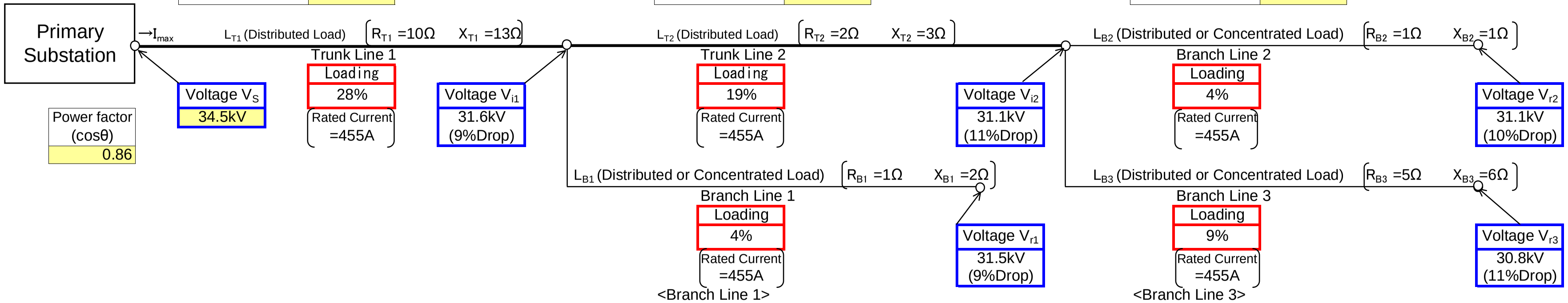
Load L_{T2}	27A
Line Type	AAC120mm2 No.7
Line Legth Len_{T2}	9km
Type of Distributed Load	Equality
Total Transformer Capacity of secondary substations CAP_{T2}	1400kVA

<Branch Line 2>

Load L_{B2}	19A
Line Type	AAC120mm2 No.7
Type of Load	Equality
Line Length Len_{B1}	3km
Total Transformer Capacity of secondary substations CAP_{B2}	980kVA

Maximum Current I_{max}
128A

Power factor (cosθ)
0.86



<Branch Line 1>

Load L_{B1}	18A
Line Type	AAC120mm2 No.7
Type of Load	Equality
Line Length Len_{B1}	5km
Total Transformer Capacity of secondary substations CAP_{B1}	950kVA

<Branch Line 3>

Load L_{B3}	39A
Line Type	AAC120mm2 No.7
Type of Load	Equality
Line Length Len_{B3}	18km
Total Transformer Capacity of secondary substations CAP_{B3}	2050kVA

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}
135A

Power factor (cosθ)
0.86

<Trank Line 1>

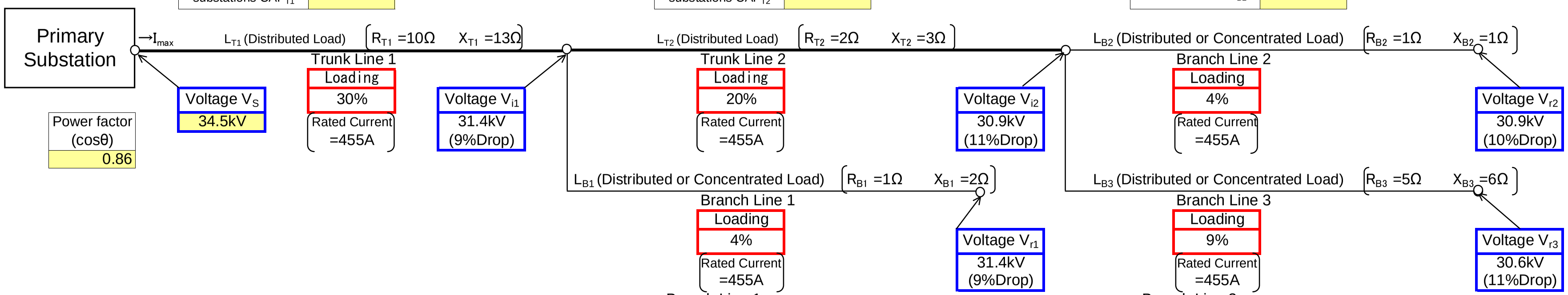
Load L_{T1}	26A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	35km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1300kVA	

<Trank Line 2>

Load L_{T2}	28A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1400kVA	

<Branch Line 2>

Load L_{B2}	20A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	3km	
Total Transformer Capacity of secondary substations CAP_{B2}	980kVA	



<Branch Line 1>

Load L_{B1}	19A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	5km	
Total Transformer Capacity of secondary substations CAP_{B1}	950kVA	

<Branch Line 3>

Load L_{B3}	41A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	18km	
Total Transformer Capacity of secondary substations CAP_{B3}	2050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	28A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	35km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1300kVA	

<Trank Line 2>

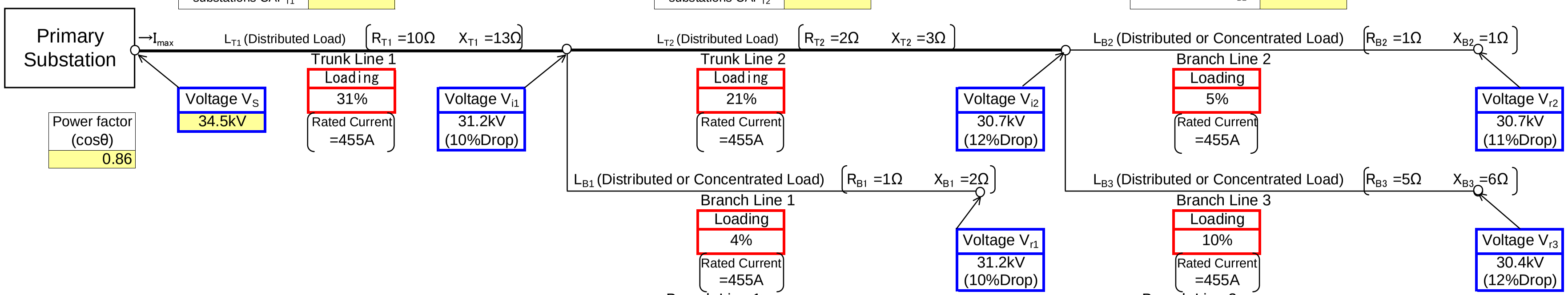
Load L_{T2}	30A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1400kVA	

<Branch Line 2>

Load L_{B2}	21A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	3km	
Total Transformer Capacity of secondary substations CAP_{B2}	980kVA	

Maximum Current I_{max}
143A

Power factor (cosθ)
0.86



<Branch Line 1>

Load L_{B1}	20A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	5km	
Total Transformer Capacity of secondary substations CAP_{B1}	950kVA	

<Branch Line 3>

Load L_{B3}	44A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	18km	
Total Transformer Capacity of secondary substations CAP_{B3}	2050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}
151A

Power factor (cosθ)
0.86

<Trank Line 1>

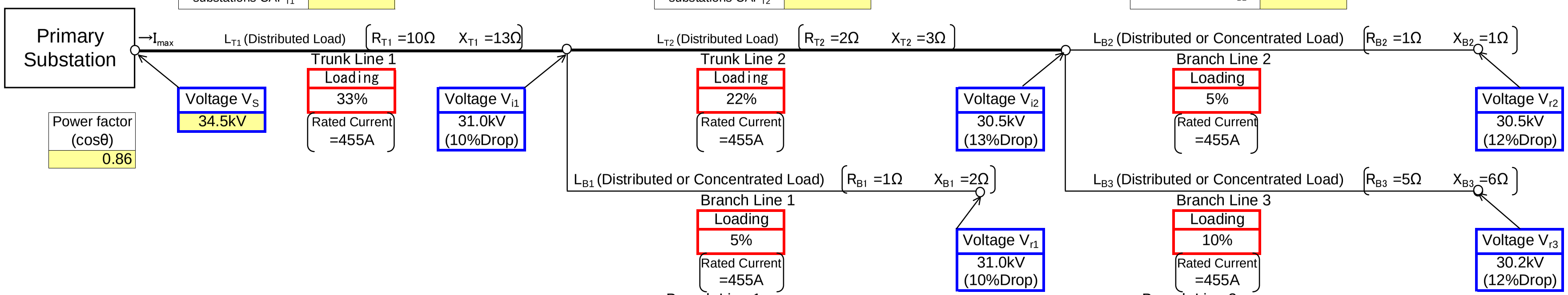
Load L_{T1}	29A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	35km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1300kVA	

<Trank Line 2>

Load L_{T2}	32A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1400kVA	

<Branch Line 2>

Load L_{B2}	22A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	3km	
Total Transformer Capacity of secondary substations CAP_{B2}	980kVA	



<Branch Line 1>

Load L_{B1}	21A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	5km	
Total Transformer Capacity of secondary substations CAP_{B1}	950kVA	

<Branch Line 3>

Load L_{B3}	46A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	18km	
Total Transformer Capacity of secondary substations CAP_{B3}	2050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	SALTPOND

: Input data in colored cells

Type-3

Maximum Current I_{max}
160A

Power factor (cosθ)
0.86

<Trank Line 1>

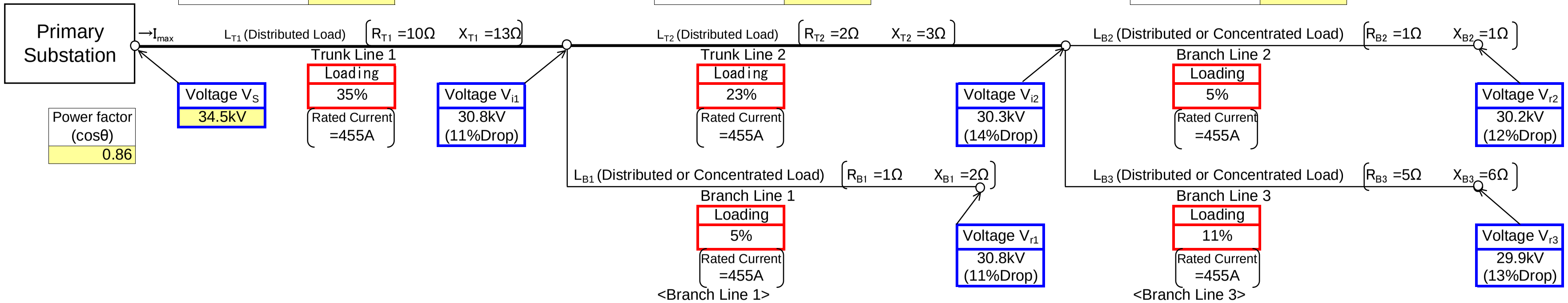
Load L_{T1}	31A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	35km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1300kVA	

<Trank Line 2>

Load L_{T2}	34A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	9km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	1400kVA	

<Branch Line 2>

Load L_{B2}	23A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	3km	
Total Transformer Capacity of secondary substations CAP_{B2}	980kVA	



<Branch Line 1>

Load L_{B1}	23A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	5km	
Total Transformer Capacity of secondary substations CAP_{B1}	950kVA	

<Branch Line 3>

Load L_{B3}	49A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B3}	18km	
Total Transformer Capacity of secondary substations CAP_{B3}	2050kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage
V_{i1} : Interim Voltage
V_{i2} : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
V_{r3} : Received Voltage

I_{max} : Maximum Current
L_{T1} : Load (Trunk line 1)
L_{T2} : Load (Trunk line 2)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
L_{B3} : Load (Branch Line 3)

$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
$CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3}$: Total Transformer Capacity of secondary substations
cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 1

: Input data in colored cells

Type-3

Maximum Current I_{max}	185A
Power factor (cosθ)	0.86

Primary Substation

Voltage V_s: 11.5kV

<Trank Line 1>

Load L_{T1}	63A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1225kVA	

$\rightarrow I_{max}$ L_{T1} (Distributed Load) (R_{T1} =4Ω X_{T1} =5Ω)

Trunk Line 1: Loading 41%, Rated Current =455A

Voltage V_{i1}: 10.0kV (13%Drop)

<Trank Line 2>

Load L_{T2}	122A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	12km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2345kVA	

L_{T2} (Distributed Load) (R_{T2} =3Ω X_{T2} =4Ω)

Trunk Line 2: Loading 27%, Rated Current =455A

Voltage V_{i2}: 9.5kV (20%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1: Loading #DIV/0!, Rated Current =A

Voltage V_{r1}: 10.0kV (13%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2: Loading #DIV/0!, Rated Current =A

Voltage V_{r2}: 9.5kV (18%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!, Rated Current =A

Voltage V_{r3}: 9.5kV (18%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
191A

Power factor (cosθ)
0.86

<Trank Line 1>

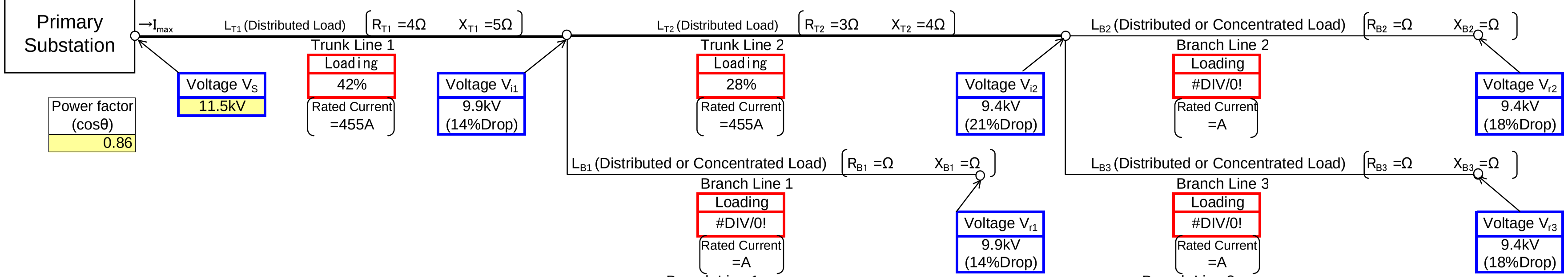
Load L_{T1}	66A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1225kVA	

<Trank Line 2>

Load L_{T2}	125A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	12km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2345kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 1

: Input data in colored cells

Type-3

Maximum Current I_{max}	196A
Power factor (cosθ)	0.86

Primary Substation →I_{max}

Voltage V_s: 11.5kV

<Trank Line 1>

Load L_{T1}	67A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1225kVA	

L_{T1} (Distributed Load) (R_{T1} =4Ω X_{T1} =5Ω)

Trunk Line 1: Loading 43%; Rated Current =455A

Voltage V_{i1}: 9.9kV (14%Drop)

<Trank Line 2>

Load L_{T2}	129A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	12km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2345kVA	

L_{T2} (Distributed Load) (R_{T2} =3Ω X_{T2} =4Ω)

Trunk Line 2: Loading 28%; Rated Current =455A

Voltage V_{i2}: 9.3kV (22%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2: Loading #DIV/0!; Rated Current =A

Voltage V_{r2}: 9.3kV (19%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1: Loading #DIV/0!; Rated Current =A

Voltage V_{r1}: 9.9kV (14%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!; Rated Current =A

Voltage V_{r3}: 9.3kV (19%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
202A

Power factor (cosθ)
0.86

<Trank Line 1>

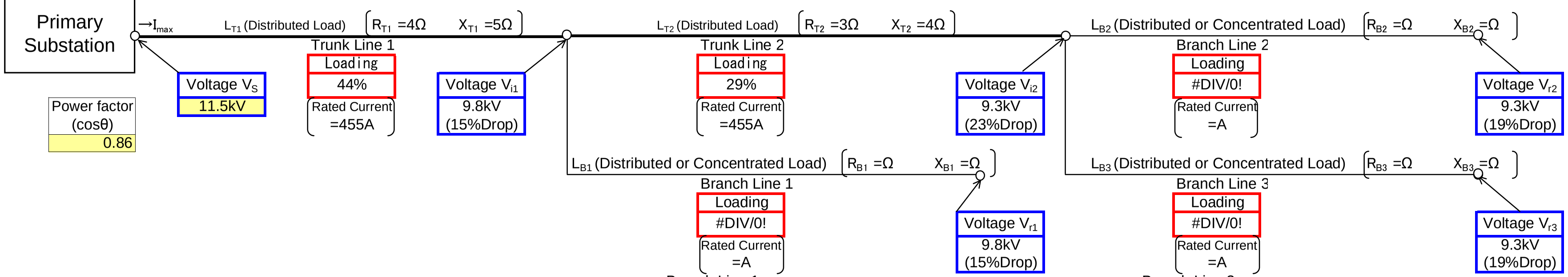
Load L_{T1}	69A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1225kVA	

<Trank Line 2>

Load L_{T2}	133A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	12km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2345kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
208A

Power factor (cosθ)
0.86

<Trank Line 1>

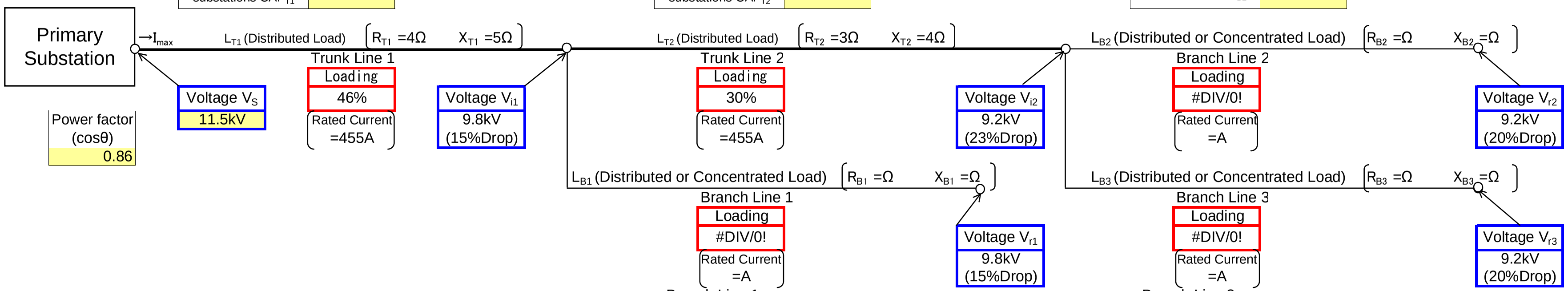
Load L_{T1}	71A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1225kVA	

<Trank Line 2>

Load L_{T2}	137A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	12km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2345kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 1

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	74A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1225kVA	

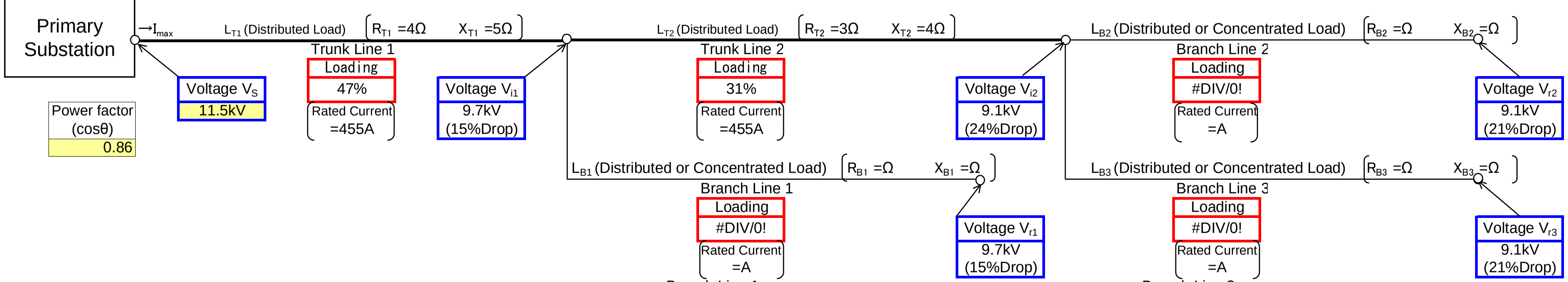
<Trank Line 2>

Load L_{T2}	141A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	12km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2345kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}	215A
Power factor (cosθ)	0.86



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
221A

Power factor (cosθ)
0.86

<Trank Line 1>

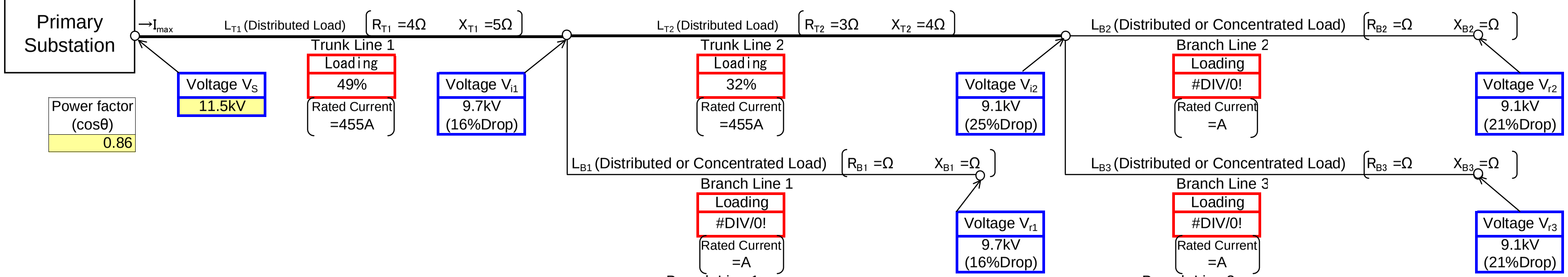
Load L_{T1}	76A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1225kVA	

<Trank Line 2>

Load L_{T2}	145A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	12km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2345kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 1

: Input data in colored cells

Type-3

Maximum Current I_{max}	
228A	

Power factor (cosθ)	
0.86	

Primary Substation →I_{max}

Voltage V_S: 11.5kV

<Trank Line 1>

Load L_{T1}	78A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1225kVA	

L_{T1} (Distributed Load) (R_{T1} =4Ω X_{T1} =5Ω)

Trunk Line 1 — Loading: 50% — Rated Current =455A

Voltage V_{i1}: 9.6kV (16%Drop)

<Trank Line 2>

Load L_{T2}	150A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	12km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2345kVA	

L_{T2} (Distributed Load) (R_{T2} =3Ω X_{T2} =4Ω)

Trunk Line 2 — Loading: 33% — Rated Current =455A

Voltage V_{i2}: 9.0kV (26%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1 — Loading: #DIV/0! — Rated Current =A

Voltage V_{r1}: 9.6kV (16%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2 — Loading: #DIV/0! — Rated Current =A

Voltage V_{r2}: 9.0kV (22%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 — Loading: #DIV/0! — Rated Current =A

Voltage V_{r3}: 9.0kV (22%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 1

: Input data in colored cells

Type-3

Maximum Current I_{max}	
234A	

Power factor (cosθ)	
0.86	

<Trank Line 1>

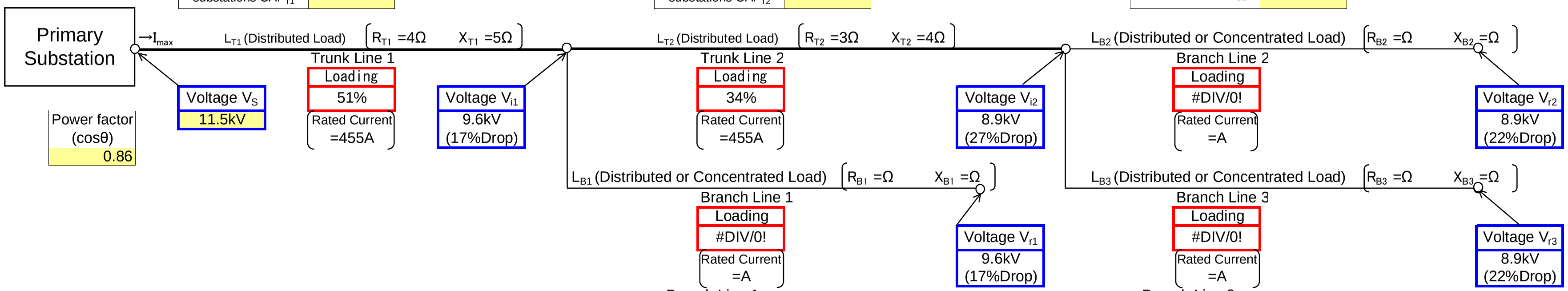
Load L_{T1}	80A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1225kVA	

<Trank Line 2>

Load L_{T2}	154A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	12km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2345kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
241A

Power factor (cosθ)
0.86

<Trank Line 1>

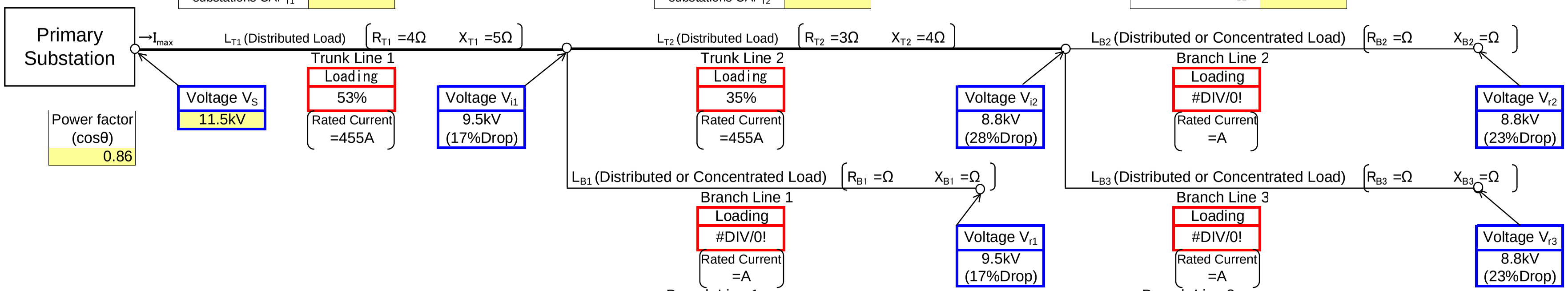
Load L_{T1}	83A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1225kVA	

<Trank Line 2>

Load L_{T2}	158A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	12km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2345kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 1

: Input data in colored cells

Type-3

Maximum Current I_{max}	
249A	

Power factor (cosθ)	
0.86	

<Trank Line 1>

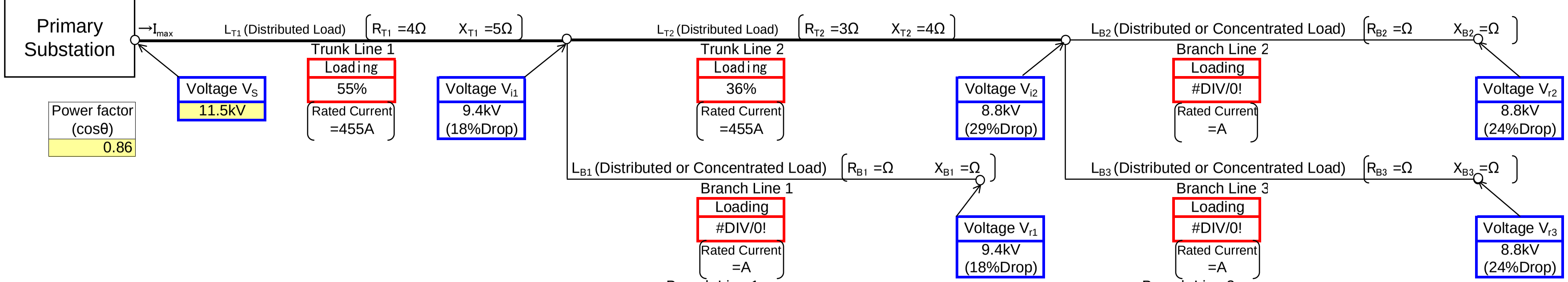
Load L_{T1}	85A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1225kVA	

<Trank Line 2>

Load L_{T2}	164A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	12km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2345kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
256A

Power factor (cosθ)
0.86

<Trank Line 1>

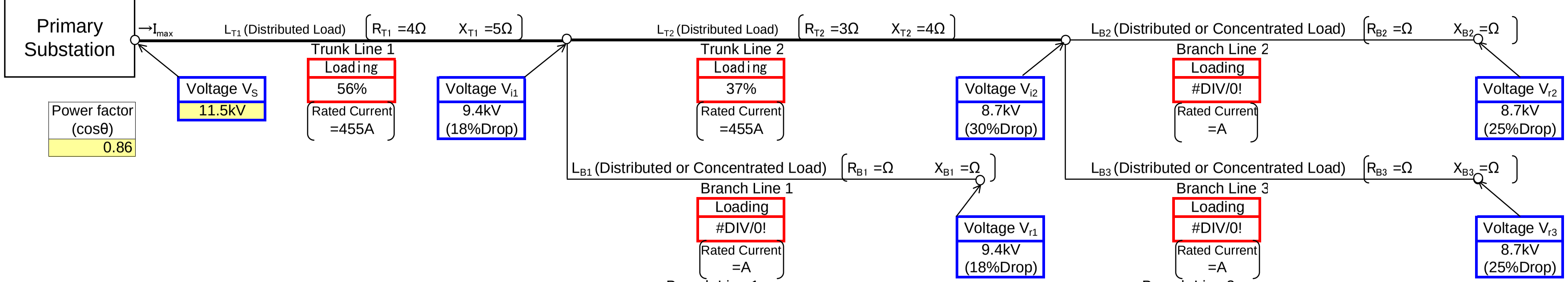
Load L_{T1}	88A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	14km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1225kVA	

<Trank Line 2>

Load L_{T2}	168A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	12km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2345kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 2

: Input data in colored cells

Type-3

Primary Substation

Maximum Current I_{max}	280A
Power factor (cosθ)	0.86

Voltage V_s: 11.5kV

<Trank Line 1>

Load L_{T1}	76A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	17km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2950kVA	

$\rightarrow I_{max}$ L_{T1} (Distributed Load) (R_{T1} =5Ω X_{T1} =6Ω)

Trunk Line 1: Loading 62%, Rated Current =455A

Voltage V_{i1}: 8.6kV (25%Drop)

<Trank Line 2>

Load L_{T2}	54A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	21km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2075kVA	

L_{T2} (Distributed Load) (R_{T2} =6Ω X_{T2} =7Ω)

Trunk Line 2: Loading 12%, Rated Current =455A

Voltage V_{i2}: 8.2kV (38%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2: Loading #DIV/0!, Rated Current =A

Voltage V_{r2}: 8.2kV (29%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =4Ω X_{B1} =5Ω)

Branch Line 1: Loading 33%, Rated Current =455A

Voltage V_{r1}: 7.9kV (32%Drop)

<Branch Line 1>

Load L_{B1}	150A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	5795kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!, Rated Current =A

Voltage V_{r3}: 8.2kV (29%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
289A

Power factor (cosθ)
0.86

Primary Substation →I_{max}

<Trank Line 1>

Load L_{T1}	79A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	17km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2950kVA	

<Trank Line 2>

Load L_{T2}	55A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	21km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2075kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{T1} (Distributed Load) (R_{T1} =5Ω X_{T1} =6Ω)
Trunk Line 1: Loading 64%; Rated Current =455A
Voltage V_S: 11.5kV
Voltage V_{i1}: 8.5kV (26%Drop)

L_{T2} (Distributed Load) (R_{T2} =6Ω X_{T2} =7Ω)
Trunk Line 2: Loading 12%; Rated Current =455A
Voltage V_{i2}: 8.1kV (40%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)
Branch Line 2: Loading #DIV/0!; Rated Current =A
Voltage V_{r2}: 8.1kV (30%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =4Ω X_{B1} =5Ω)
Branch Line 1: Loading 34%; Rated Current =455A
Voltage V_{r1}: 7.7kV (33%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)
Branch Line 3: Loading #DIV/0!; Rated Current =A
Voltage V_{r3}: 8.1kV (30%Drop)

<Branch Line 1>

Load L_{B1}	155A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	5795kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

- V_s : Supply Voltage
- V_{i1} : Interim Voltage
- V_{i2} : Interim Voltage
- V_{r1} : Received Voltage
- V_{r2} : Received Voltage
- V_{r3} : Received Voltage
- I_{max} : Maximum Current
- L_{T1} : Load (Trunk line 1)
- L_{T2} : Load (Trunk line 2)
- L_{B1} : Load (Branch Line 1)
- L_{B2} : Load (Branch Line 2)
- L_{B3} : Load (Branch Line 3)
- R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3} : Resistance
- X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3} : Reactance
- f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3} : Dispersal Load Factor
- CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
- cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 2

: Input data in colored cells

Type-3

Maximum Current I_{max}	298A
Power factor (cosθ)	0.86

Primary Substation →I_{max}

Voltage V_s: 11.5kV

<Trank Line 1>

Load L_{T1}	81A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	17km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2950kVA	

L_{T1} (Distributed Load) (R_{T1} =5Ω X_{T1} =6Ω)

Trunk Line 1: Loading 65%, Rated Current =455A

Voltage V_{i1}: 8.4kV (27%Drop)

<Trank Line 2>

Load L_{T2}	57A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	21km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2075kVA	

L_{T2} (Distributed Load) (R_{T2} =6Ω X_{T2} =7Ω)

Trunk Line 2: Loading 13%, Rated Current =455A

Voltage V_{i2}: 8.0kV (42%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =4Ω X_{B1} =5Ω)

Branch Line 1: Loading 35%, Rated Current =455A

Voltage V_{r1}: 7.6kV (34%Drop)

<Branch Line 1>

Load L_{B1}	160A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	5795kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2: Loading #DIV/0!, Rated Current =A

Voltage V_{r2}: 8.0kV (31%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!, Rated Current =A

Voltage V_{r3}: 8.0kV (31%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage
V_{i1} : Interim Voltage
V_{i2} : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
V_{r3} : Received Voltage

I_{max} : Maximum Current
L_{T1} : Load (Trunk line 1)
L_{T2} : Load (Trunk line 2)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
L_{B3} : Load (Branch Line 3)

$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
$CAP_{T1}, CAP_{T2}, CAP_{B1}$, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
308A

Power factor (cosθ)
0.86

<Trank Line 1>

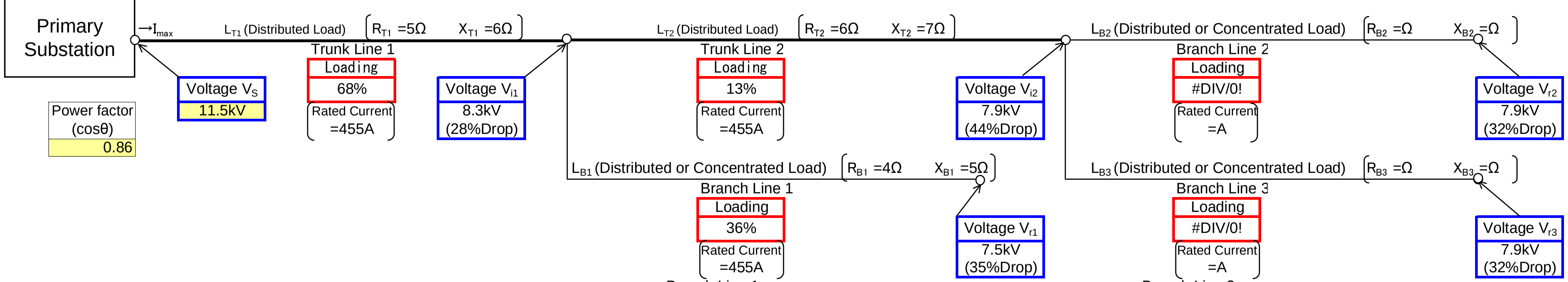
Load L_{T1}	84A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	17km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2950kVA	

<Trank Line 2>

Load L_{T2}	59A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	21km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2075kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	165A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	5795kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 2

: Input data in colored cells

Type-3

Maximum Current I_{max}	Power factor (cosθ)
318A	0.86

<Trank Line 1>

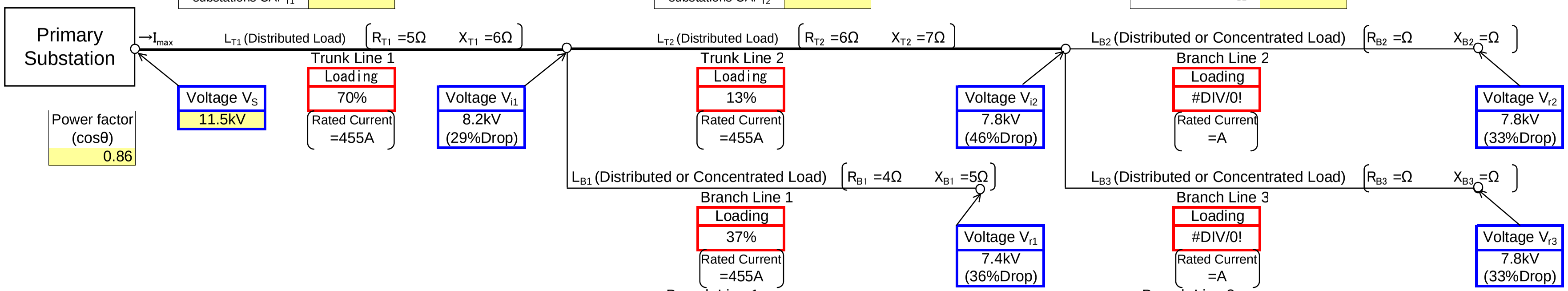
Load L_{T1}	87A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	17km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2950kVA	

<Trank Line 2>

Load L_{T2}	61A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	21km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2075kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	170A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	5795kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
328A

Power factor (cosθ)
0.86

<Trank Line 1>

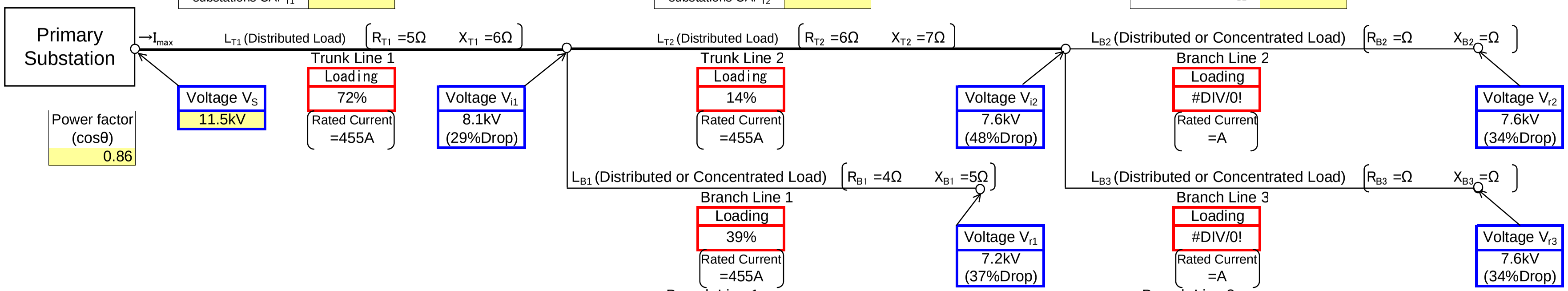
Load L_{T1}	89A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	17km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2950kVA	

<Trank Line 2>

Load L_{T2}	63A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	21km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2075kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	176A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	5795kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
339A

Power factor (cosθ)
0.86

<Trank Line 1>

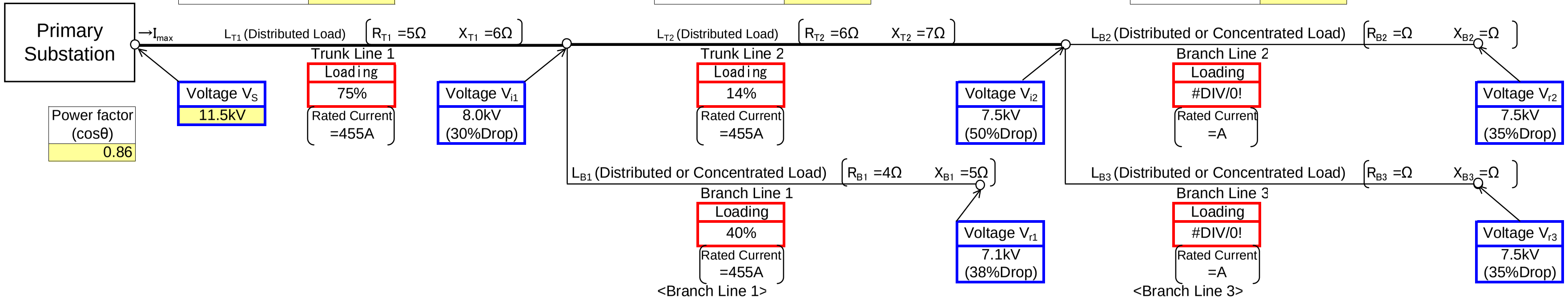
Load L_{T1}	92A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	17km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2950kVA	

<Trank Line 2>

Load L_{T2}	65A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	21km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2075kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	182A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	5795kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
350A

Power factor (cosθ)
0.86

<Trank Line 1>

Load L_{T1}	95A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	17km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2950kVA	

<Trank Line 2>

Load L_{T2}	67A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	21km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2075kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Primary Substation →I_{max}

Voltage V_S: 11.5kV

L_{T1} (Distributed Load) (R_{T1} =5Ω X_{T1} =6Ω)
Trunk Line 1: Loading 77%, Rated Current =455A

Voltage V_{i1}: 7.9kV (31%Drop)

L_{T2} (Distributed Load) (R_{T2} =6Ω X_{T2} =7Ω)
Trunk Line 2: Loading 15%, Rated Current =455A

Voltage V_{i2}: 7.4kV (52%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)
Branch Line 2: Loading #DIV/0!, Rated Current =A

Voltage V_{r2}: 7.4kV (36%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =4Ω X_{B1} =5Ω)
Branch Line 1: Loading 41%, Rated Current =455A

Voltage V_{r1}: 6.9kV (40%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)
Branch Line 3: Loading #DIV/0!, Rated Current =A

Voltage V_{r3}: 7.4kV (36%Drop)

<Branch Line 1>

Load L_{B1}	187A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	5795kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 2

: Input data in colored cells

Type-3

Maximum Current I_{max}	361A
Power factor (cosθ)	0.86

<Trank Line 1>

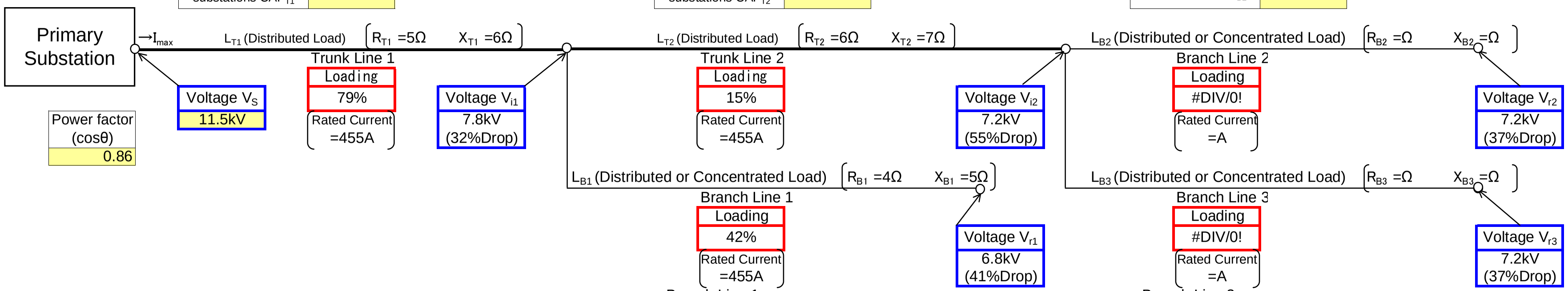
Load L_{T1}	98A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	17km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2950kVA	

<Trank Line 2>

Load L_{T2}	69A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	21km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2075kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	193A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	5795kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
373A

Power factor (cosθ)
0.86

<Trank Line 1>

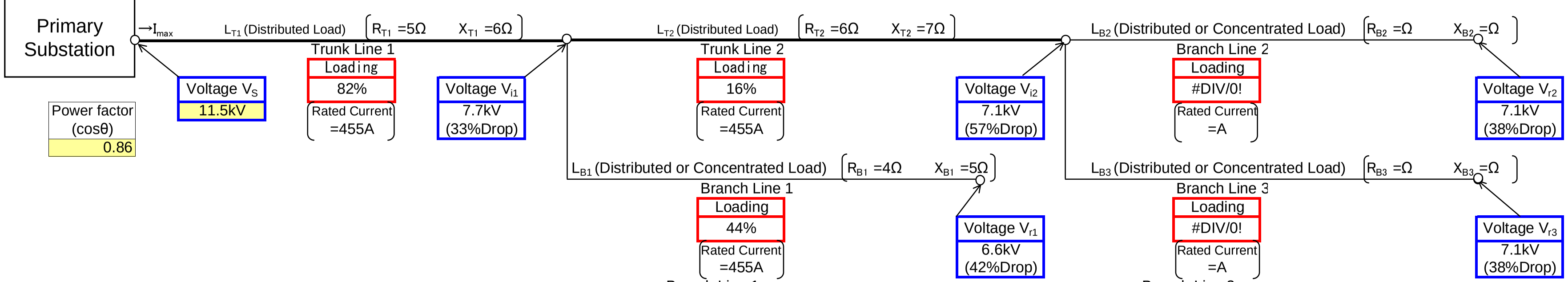
Load L_{T1}	102A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	17km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2950kVA	

<Trank Line 2>

Load L_{T2}	72A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	21km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2075kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	200A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	5795kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
385A

Power factor (cosθ)
0.86

<Trank Line 1>

Load L_{T1}	105A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	17km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2950kVA	

<Trank Line 2>

Load L_{T2}	74A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	21km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2075kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Primary Substation →I_{max}

L_{T1} (Distributed Load) (R_{T1} =5Ω X_{T1} =6Ω)
Trunk Line 1: Loading 85%, Rated Current =455A
Voltage V_S: 11.5kV
Voltage V_{i1}: 7.5kV (35%Drop)

L_{T2} (Distributed Load) (R_{T2} =6Ω X_{T2} =7Ω)
Trunk Line 2: Loading 16%, Rated Current =455A
Voltage V_{i2}: 7.0kV (60%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)
Branch Line 2: Loading #DIV/0!, Rated Current =A
Voltage V_{r2}: 7.0kV (39%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =4Ω X_{B1} =5Ω)
Branch Line 1: Loading 45%, Rated Current =455A
Voltage V_{r1}: 6.5kV (44%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)
Branch Line 3: Loading #DIV/0!, Rated Current =A
Voltage V_{r3}: 7.0kV (39%Drop)

<Branch Line 1>

Load L_{B1}	206A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	5795kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	SWEDRU 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
397A

Power factor (cosθ)
0.86

<Trank Line 1>

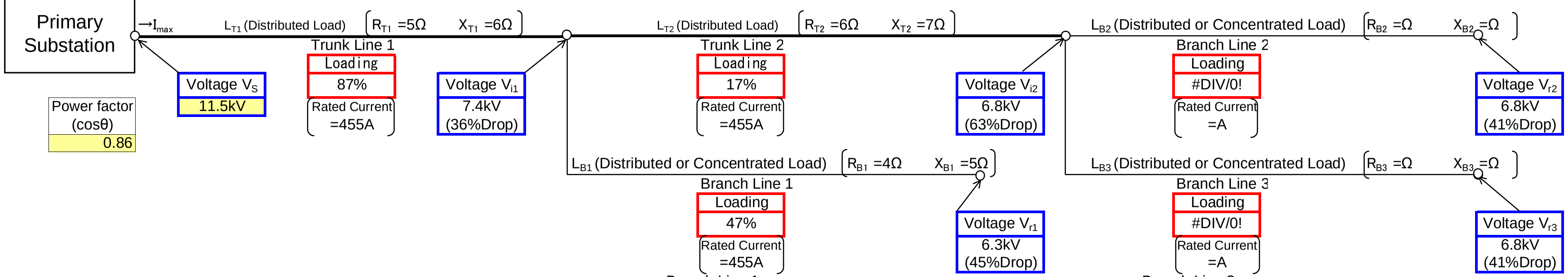
Load L_{T1}	108A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	17km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2950kVA	

<Trank Line 2>

Load L_{T2}	76A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	21km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2075kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	213A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	5795kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 2

: Input data in colored cells

Type-3

Maximum Current I_{max}	
330A	

Power factor (cosθ)	
0.86	

<Trank Line 1>

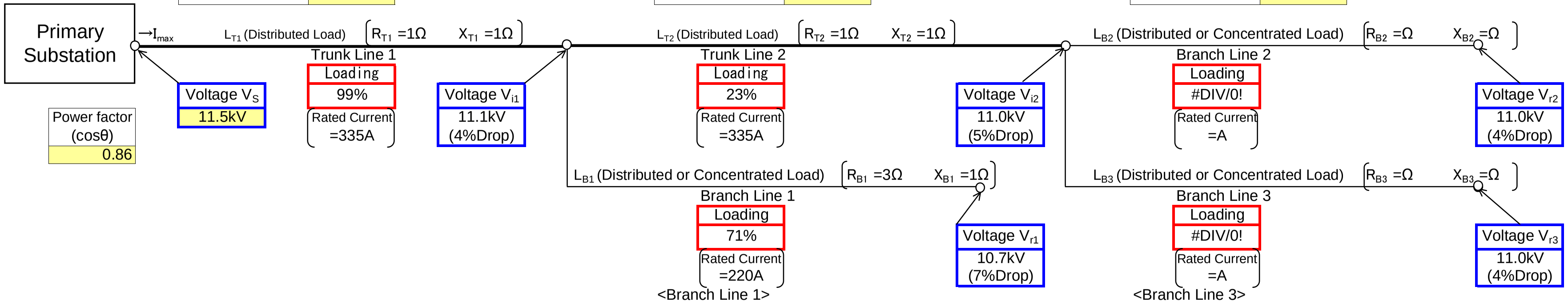
Load L_{T1}	96A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	78A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	156A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4070kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 2

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	99A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

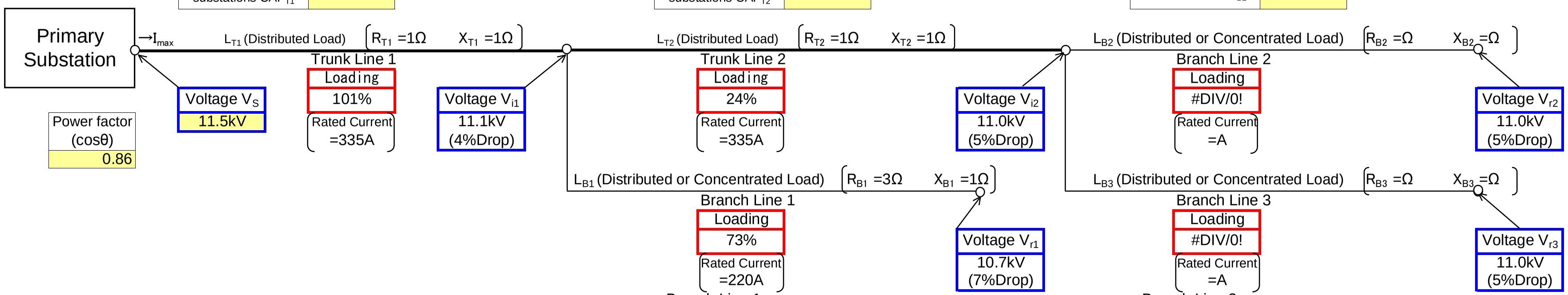
Load L_{T2}	80A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}
339A

Power factor (cosθ)
0.86



<Branch Line 1>

Load L_{B1}	160A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4070kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 2

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	101A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	82A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}	347A
Power factor (cosθ)	0.86

Primary Substation

→I_{max}

Voltage V_S: 11.5kV

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)

Trunk Line 1 — Loading 104% (Rated Current =335A)

Voltage V_{i1}: 11.1kV (4%Drop)

L_{T2} (Distributed Load) (R_{T2} =1Ω X_{T2} =1Ω)

Trunk Line 2 — Loading 24% (Rated Current =335A)

Voltage V_{i2}: 11.0kV (5%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2 — Loading #DIV/0! (Rated Current =A)

Voltage V_{r2}: 11.0kV (5%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =3Ω X_{B1} =1Ω)

Branch Line 1 — Loading 75% (Rated Current =220A)

Voltage V_{r1}: 10.6kV (7%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 — Loading #DIV/0! (Rated Current =A)

Voltage V_{r3}: 11.0kV (5%Drop)

<Branch Line 1>

Load L_{B1}	164A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4070kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
356A

Power factor (cosθ)
0.86

<Trank Line 1>

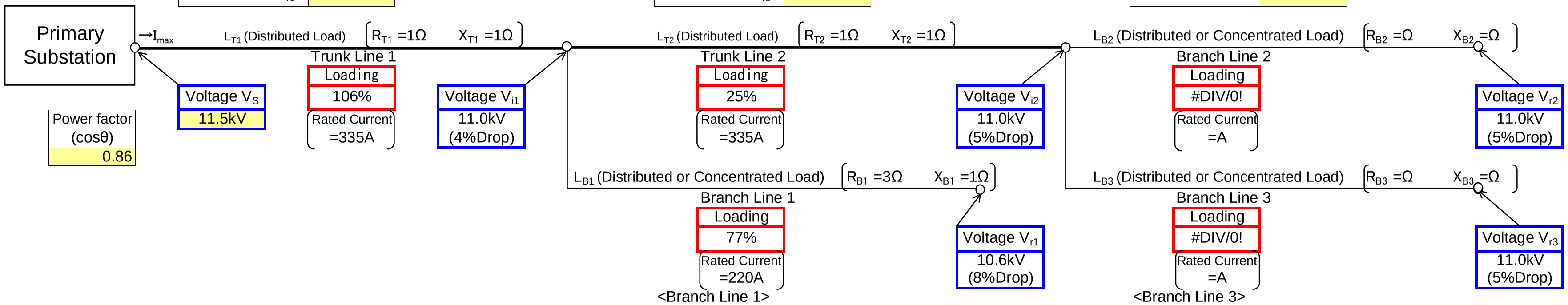
Load L_{T1}	103A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	84A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	168A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4070kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
366A

Power factor (cosθ)
0.86

<Trank Line 1>

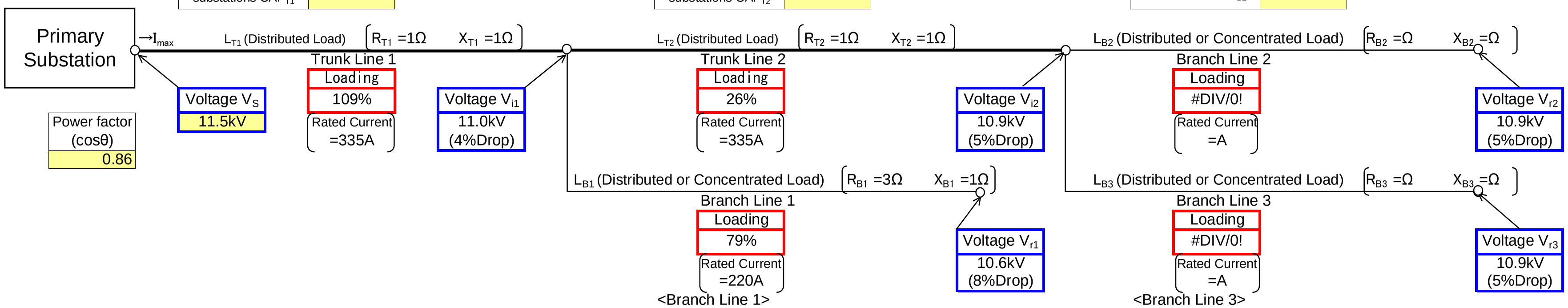
Load L_{T1}	106A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	86A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	173A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4070kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 2

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	109A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	89A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}
375A

Primary Substation

$\rightarrow I_{max}$

Power factor (cosθ)
0.86

Voltage V_s: 11.5kV

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)

Trunk Line 1 — Loading 112% — Rated Current =335A

Voltage V_{i1}: 11.0kV (4%Drop)

L_{T2} (Distributed Load) (R_{T2} =1Ω X_{T2} =1Ω)

Trunk Line 2 — Loading 26% — Rated Current =335A

Voltage V_{i2}: 10.9kV (5%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2 — Loading #DIV/0! — Rated Current =A

Voltage V_{r2}: 10.9kV (5%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =3Ω X_{B1} =1Ω)

Branch Line 1 — Loading 81% — Rated Current =220A

Voltage V_{r1}: 10.6kV (8%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 — Loading #DIV/0! — Rated Current =A

Voltage V_{r3}: 10.9kV (5%Drop)

<Branch Line 1>

Load L_{B1}	177A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4070kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage
V_{i1} : Interim Voltage
V_{i2} : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
V_{r3} : Received Voltage

I_{max} : Maximum Current
L_{T1} : Load (Trunk line 1)
L_{T2} : Load (Trunk line 2)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
L_{B3} : Load (Branch Line 3)

$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
$CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3}$: Total Transformer Capacity of secondary substations
cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
385A

Power factor (cosθ)
0.86

<Trank Line 1>

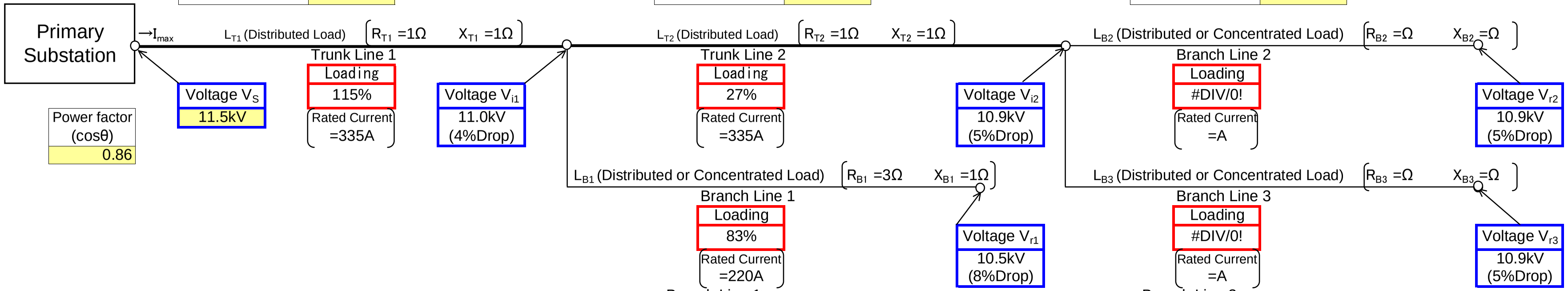
Load L_{T1}	112A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	91A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	182A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4070kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
395A

Power factor (cosθ)
0.86

<Trank Line 1>

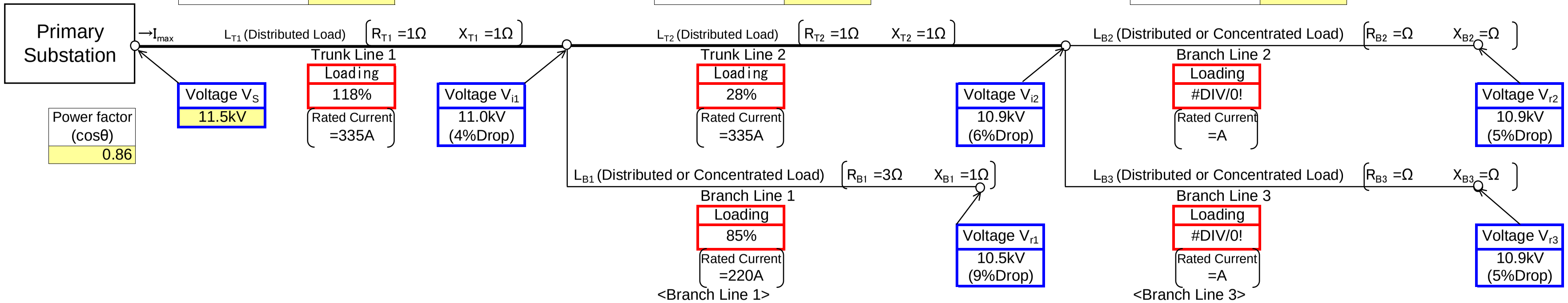
Load L_{T1}	115A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	93A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	187A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4070kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage
V_{i1} : Interim Voltage
V_{i2} : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
V_{r3} : Received Voltage

I_{max} : Maximum Current
L_{T1} : Load (Trunk line 1)
L_{T2} : Load (Trunk line 2)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
L_{B3} : Load (Branch Line 3)

$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
$CAP_{T1}, CAP_{T2}, CAP_{B1}$, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
405A

Power factor (cosθ)
0.86

<Trank Line 1>

Load L_{T1}	118A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	96A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Primary Substation →I_{max}

Voltage V_S: 11.5kV

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)

Trunk Line 1 — Loading 121% — Rated Current =335A

Voltage V_{i1}: 11.0kV (5%Drop)

L_{T2} (Distributed Load) (R_{T2} =1Ω X_{T2} =1Ω)

Trunk Line 2 — Loading 29% — Rated Current =335A

Voltage V_{i2}: 10.9kV (6%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2 — Loading #DIV/0! — Rated Current =A

Voltage V_{r2}: 10.9kV (5%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =3Ω X_{B1} =1Ω)

Branch Line 1 — Loading 87% — Rated Current =220A

Voltage V_{r1}: 10.5kV (9%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 — Loading #DIV/0! — Rated Current =A

Voltage V_{r3}: 10.9kV (5%Drop)

<Branch Line 1>

Load L_{B1}	192A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4070kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 2

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	121A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	98A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}	415A

Power factor (cosθ)	0.86

Primary Substation →I_{max}

Voltage V_s	11.5kV

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)

Trunk Line 1: Loading 124%; Rated Current =335A

Voltage V_{i1}	11.0kV (5%Drop)

L_{T2} (Distributed Load) (R_{T2} =1Ω X_{T2} =1Ω)

Trunk Line 2: Loading 29%; Rated Current =335A

Voltage V_{i2}	10.9kV (6%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2: Loading #DIV/0!; Rated Current =A

Voltage V_{r2}	10.9kV (6%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =3Ω X_{B1} =1Ω)

Branch Line 1: Loading 89%; Rated Current =220A

Voltage V_{r1}	10.5kV (9%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!; Rated Current =A

Voltage V_{r3}	10.9kV (6%Drop)

<Branch Line 1>

Load L_{B1}	196A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4070kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 2

: Input data in colored cells

Type-3

Maximum Current I_{max}
426A

Power factor (cosθ)
0.86

<Trank Line 1>

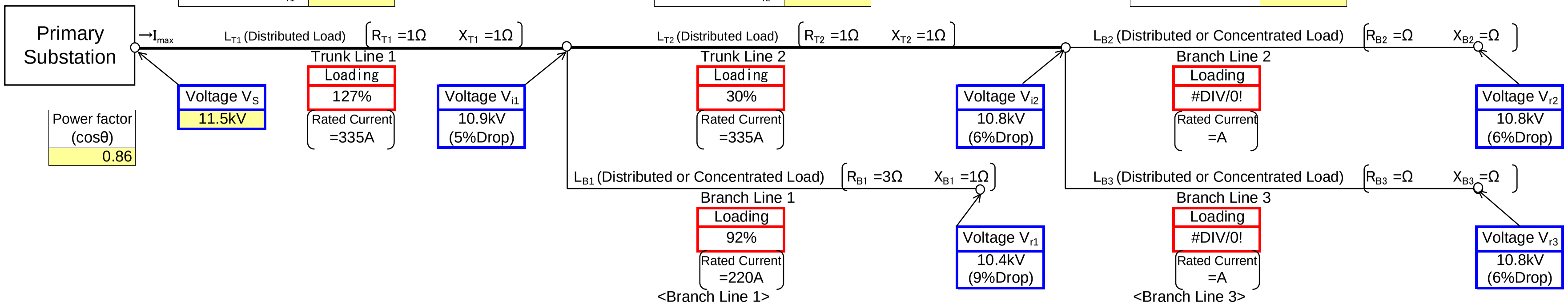
Load L_{T1}	124A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	101A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	202A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4070kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 2

: Input data in colored cells

Type-3

Maximum Current I_{max}	437A
Power factor (cosθ)	0.86

<Trank Line 1>

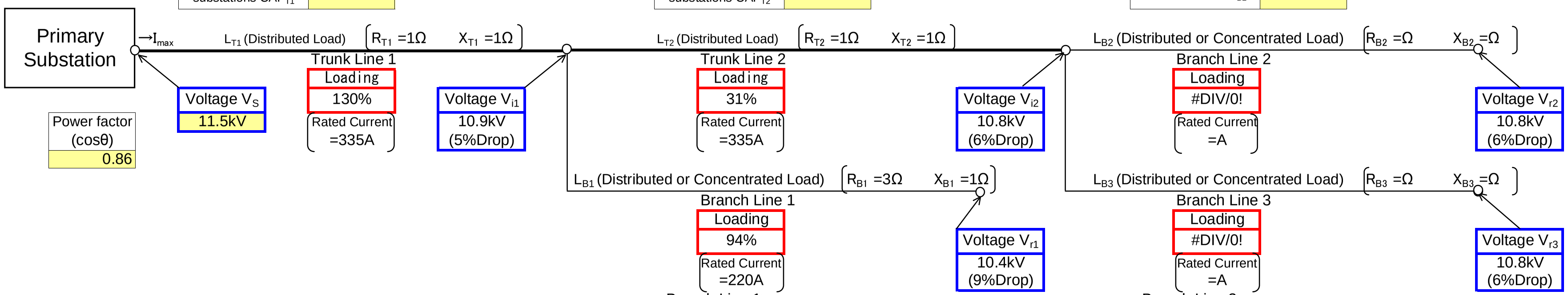
Load L_{T1}	127A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	103A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T2}	6km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	207A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	8km	
Total Transformer Capacity of secondary substations CAP_{B1}	4070kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 3

: Input data in colored cells

Type-3

Maximum Current I_{max}: 160A

Power factor (cosθ): 0.86

Primary Substation

<Trank Line 1>

Load L_{T1}	53A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	107A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	5030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

→I_{max}

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =2Ω)

Voltage V_s: 11.5kV

Trunk Line 1 — Loading: 35% — Rated Current =455A

Voltage V_{i1}: 11.1kV (4%Drop)

L_{T2} (Distributed Load) (R_{T2} =2Ω X_{T2} =2Ω)

Trunk Line 2 — Loading: 23% — Rated Current =455A

Voltage V_{i2}: 10.8kV (6%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2 — Loading: #DIV/0! — Rated Current =A

Voltage V_{r2}: 10.8kV (6%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1 — Loading: 0% — Rated Current =220A

Voltage V_{r1}: 11.1kV (4%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 — Loading: #DIV/0! — Rated Current =A

Voltage V_{r3}: 10.8kV (6%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 3

: Input data in colored cells

Type-3

Maximum Current I_{max}
164A

Power factor (cosθ)
0.86

<Trank Line 1>

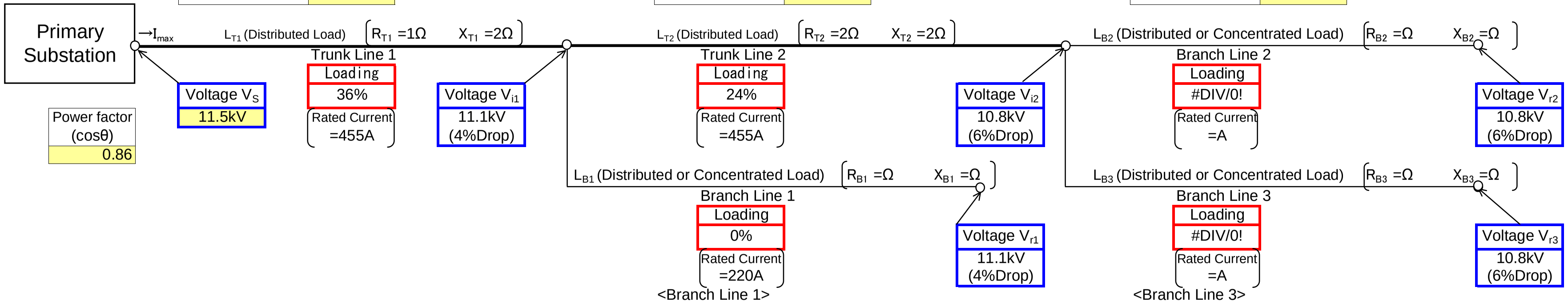
Load L_{T1}	54A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	110A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	5030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 3

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	56A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

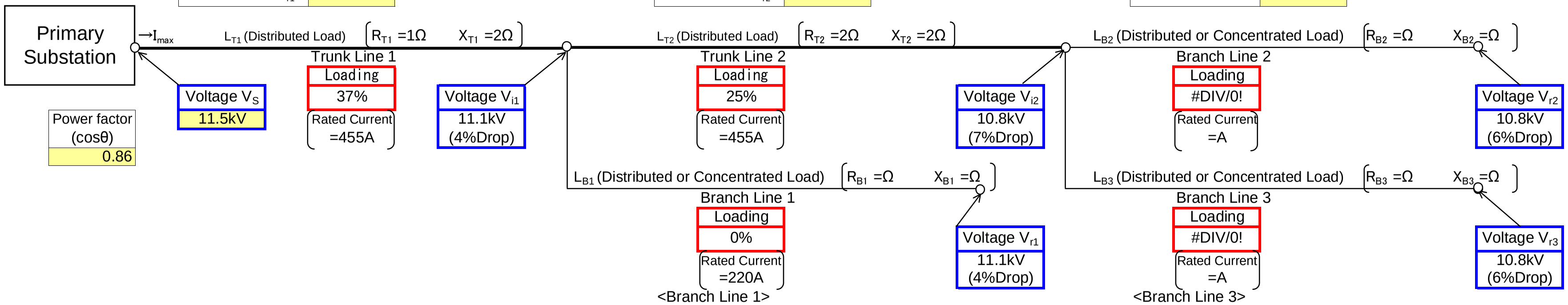
<Trank Line 2>

Load L_{T2}	113A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	5030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}	169A
Power factor (cosθ)	0.86



<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 3

: Input data in colored cells

Type-3

Maximum Current I_{max}
174A

Power factor (cosθ)
0.86

<Trank Line 1>

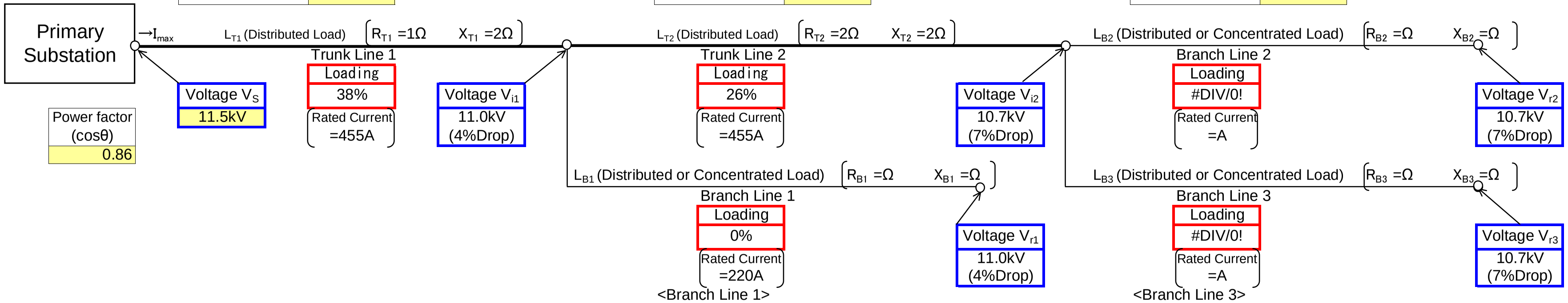
Load L_{T1}	58A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	116A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	5030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 3

: Input data in colored cells

Type-3

Maximum Current I_{max}
179A

Power factor (cosθ)
0.86

<Trank Line 1>

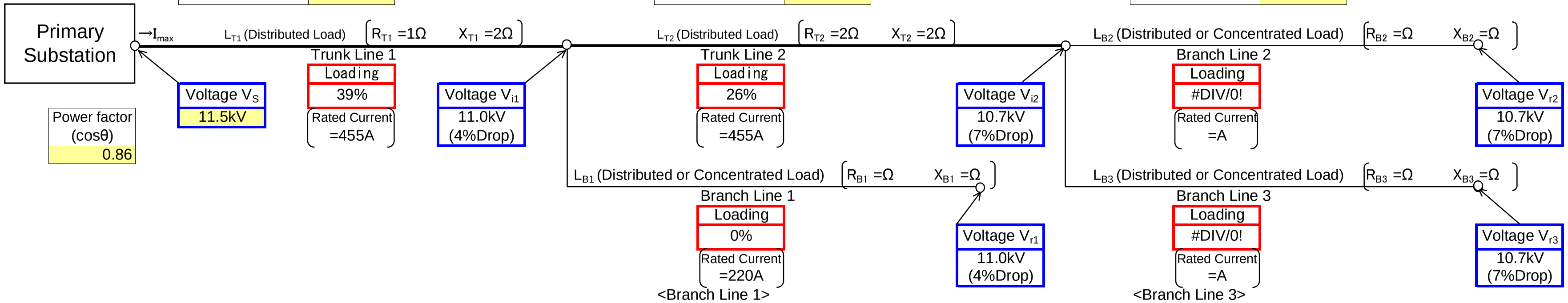
Load L_{T1}	59A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	120A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	5030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 3

: Input data in colored cells

Type-3

Maximum Current I_{max}
184A

<Trank Line 1>

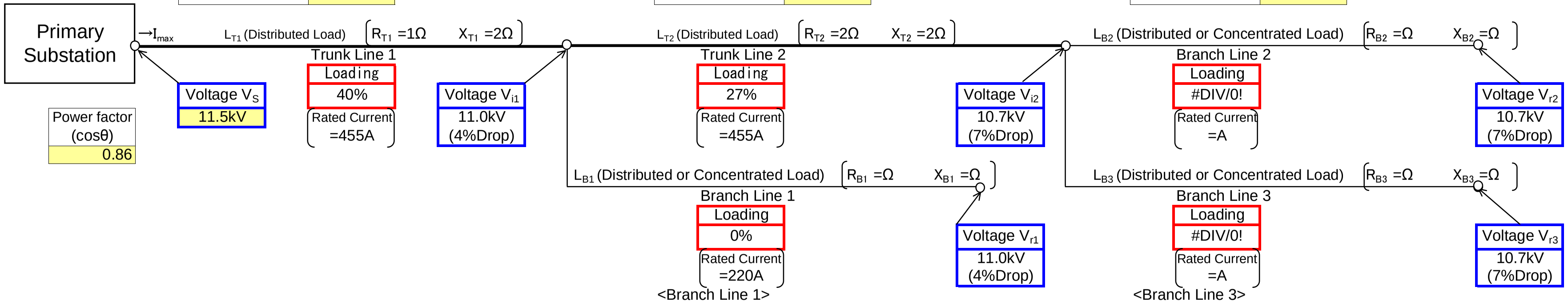
Load L_{T1}	61A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	123A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	5030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 3

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	63A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

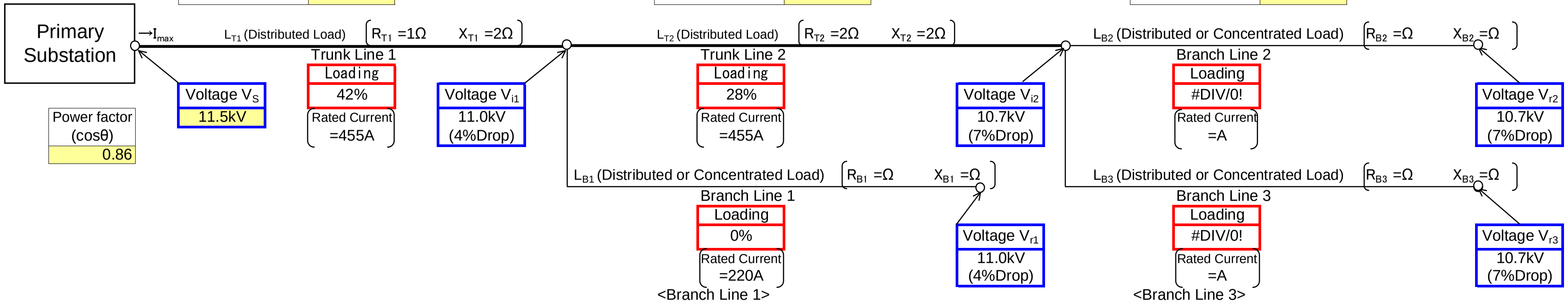
Load L_{T2}	126A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	5030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}
189A

Power factor (cosθ)
0.86



<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 3

: Input data in colored cells

Type-3

Maximum Current I_{max}
194A

Power factor (cosθ)
0.86

<Trank Line 1>

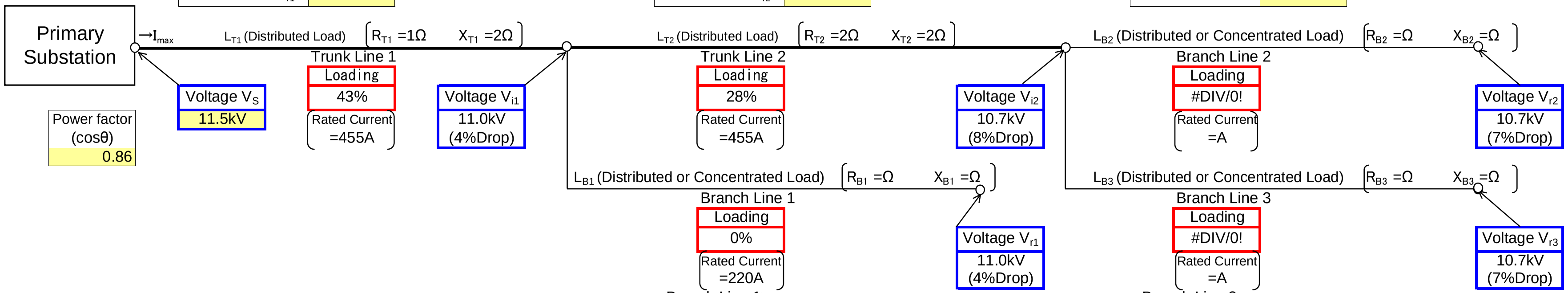
Load L_{T1}	64A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	130A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	5030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 3

: Input data in colored cells

Type-3

Maximum Current I_{max}
199A

Power factor (cosθ)
0.86

<Trank Line 1>

Load L_{T1}	66A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	133A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	5030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Primary Substation →I_{max}

Voltage V_S: 11.5kV

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =2Ω)

Trunk Line 1 — Loading 44% — Rated Current =455A

Voltage V_{i1}: 11.0kV (5%Drop)

L_{T2} (Distributed Load) (R_{T2} =2Ω X_{T2} =2Ω)

Trunk Line 2 — Loading 29% — Rated Current =455A

Voltage V_{i2}: 10.6kV (8%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2 — Loading #DIV/0! — Rated Current =A

Voltage V_{r2}: 10.6kV (8%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1 — Loading 0% — Rated Current =220A

Voltage V_{r1}: 11.0kV (5%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 — Loading #DIV/0! — Rated Current =A

Voltage V_{r3}: 10.6kV (8%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 3

: Input data in colored cells

Type-3

Maximum Current I_{max}
205A

Power factor (cosθ)
0.86

Primary Substation

→I_{max}

Voltage V_s
11.5kV

<Trank Line 1>

Load L_{T1}	68A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =2Ω)

Trunk Line 1: Loading 45%, Rated Current =455A

Voltage V_{i1}
11.0kV (5%Drop)

<Trank Line 2>

Load L_{T2}	137A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	5030kVA	

L_{T2} (Distributed Load) (R_{T2} =2Ω X_{T2} =2Ω)

Trunk Line 2: Loading 30%, Rated Current =455A

Voltage V_{i2}
10.6kV (8%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1: Loading 0%, Rated Current =220A

Voltage V_{r1}
11.0kV (5%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2: Loading #DIV/0!, Rated Current =A

Voltage V_{r2}
10.6kV (8%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!, Rated Current =A

Voltage V_{r3}
10.6kV (8%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 3

: Input data in colored cells

Type-3

Maximum Current I_{max}
211A

<Trank Line 1>

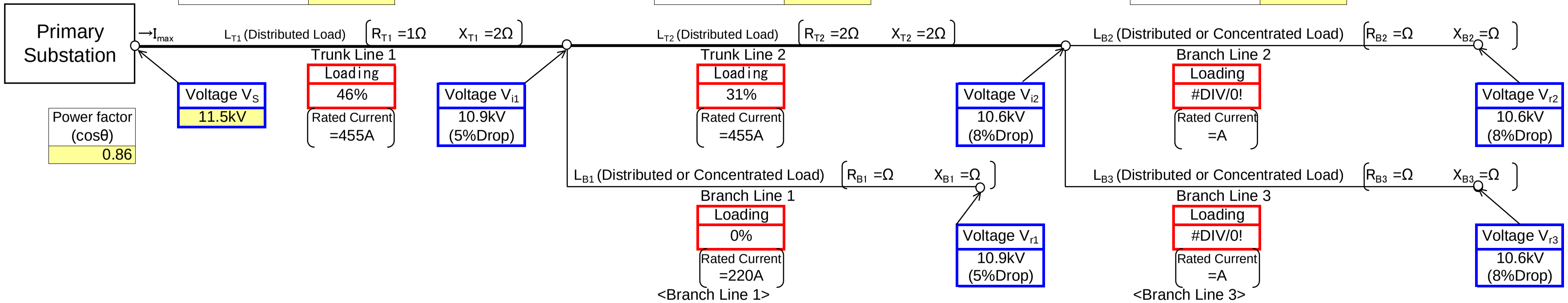
Load L_{T1}	70A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	141A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	5030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 3

: Input data in colored cells

Type-3

Maximum Current I_{max}
216A

Power factor (cosθ)
0.86

<Trank Line 1>

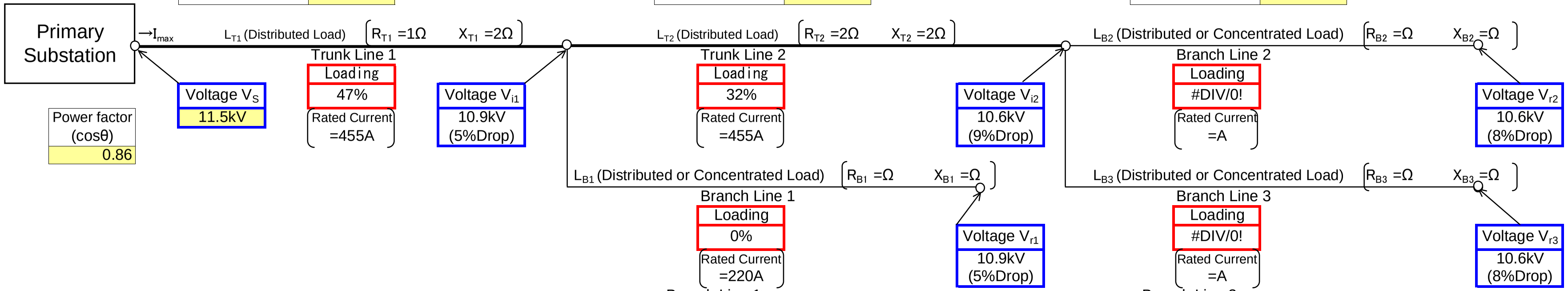
Load L_{T1}	72A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	4km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2500kVA	

<Trank Line 2>

Load L_{T2}	144A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	7km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	5030kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
85A

Power factor (cosθ)
0.86

<Trank Line 1>

Load L_{T1}	77A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1845kVA	

<Trank Line 2>

Load L_{T2}	8A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	200kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Primary Substation →I_{max}

Voltage V_S: 11.5kV

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)

Trunk Line 1 — Loading 25% — Rated Current =335A

Voltage V_{i1}: 11.4kV (1%Drop)

L_{T2} (Distributed Load) (R_{T2} =Ω X_{T2} =Ω)

Trunk Line 2 — Loading 2% — Rated Current =455A

Voltage V_{i2}: 11.4kV (1%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2 — Loading #DIV/0! — Rated Current =A

Voltage V_{r2}: 11.4kV (1%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1 — Loading 0% — Rated Current =220A

Voltage V_{r1}: 11.4kV (1%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 — Loading #DIV/0! — Rated Current =A

Voltage V_{r3}: 11.4kV (1%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 1

(Yellow box): Input data in colored cells

Type-3

Maximum Current I_{max}
88A

Power factor (cosθ)
0.86

<Trank Line 1>

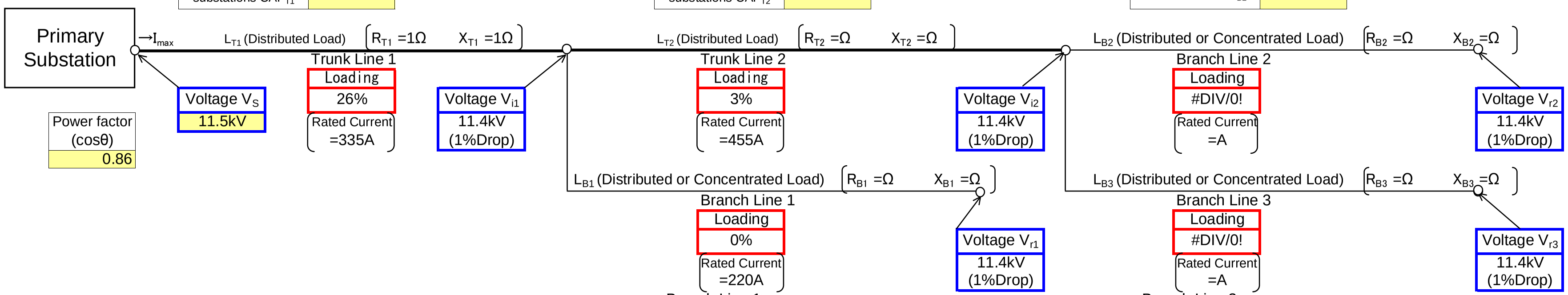
Load L_{T1}	79A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1845kVA	

<Trank Line 2>

Load L_{T2}	9A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	200kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
92A

Power factor (cosθ)
0.86

Primary Substation →I_{max}

Voltage V_S: 11.5kV

<Trank Line 1>

Load L_{T1}	83A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1845kVA	

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)

Trunk Line 1 — Loading: 27% — Rated Current =335A

Voltage V_{i1}: 11.4kV (1%Drop)

<Trank Line 2>

Load L_{T2}	9A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	200kVA	

L_{T2} (Distributed Load) (R_{T2} =Ω X_{T2} =Ω)

Trunk Line 2 — Loading: 3% — Rated Current =455A

Voltage V_{i2}: 11.4kV (1%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2 — Loading: #DIV/0! — Rated Current =A

Voltage V_{r2}: 11.4kV (1%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1 — Loading: 0% — Rated Current =220A

Voltage V_{r1}: 11.4kV (1%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 — Loading: #DIV/0! — Rated Current =A

Voltage V_{r3}: 11.4kV (1%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
95A

Power factor (cosθ)
0.86

<Trank Line 1>

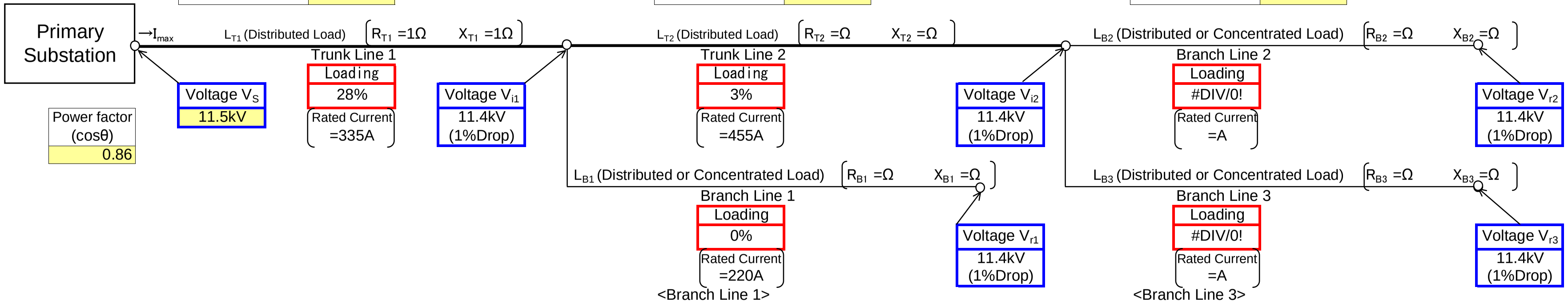
Load L_{T1}	86A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1845kVA	

<Trank Line 2>

Load L_{T2}	9A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	200kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
99A

Power factor (cosθ)
0.86

Primary Substation → I_{max}

<Trank Line 1>

Load L_{T1}	89A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1845kVA	

<Trank Line 2>

Load L_{T2}	10A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	200kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Voltage V_s: 11.5kV

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)
Trunk Line 1 — Loading 30% — Rated Current =335A

Voltage V_{i1}: 11.4kV (1%Drop)

L_{T2} (Distributed Load) (R_{T2} =Ω X_{T2} =Ω)
Trunk Line 2 — Loading 3% — Rated Current =455A

Voltage V_{i2}: 11.4kV (1%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)
Branch Line 2 — Loading #DIV/0! — Rated Current =A

Voltage V_{r2}: 11.4kV (1%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)
Branch Line 1 — Loading 0% — Rated Current =220A

Voltage V_{r1}: 11.4kV (1%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)
Branch Line 3 — Loading #DIV/0! — Rated Current =A

Voltage V_{r3}: 11.4kV (1%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 1

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	92A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1845kVA	

<Trank Line 2>

Load L_{T2}	10A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	200kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}	102A
Power factor (cosθ)	0.86

Primary Substation

$\rightarrow I_{max}$

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)

Trunk Line 1: Loading 30%, Rated Current =335A

Voltage V_S 11.5kV

Voltage V_{i1} 11.4kV (1%Drop)

L_{T2} (Distributed Load) (R_{T2} =Ω X_{T2} =Ω)

Trunk Line 2: Loading 3%, Rated Current =455A

Voltage V_{i2} 11.4kV (1%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2: Loading #DIV/0!, Rated Current =A

Voltage V_{r2} 11.4kV (1%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1: Loading 0%, Rated Current =220A

Voltage V_{r1} 11.4kV (1%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3: Loading #DIV/0!, Rated Current =A

Voltage V_{r3} 11.4kV (1%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
106A

Power factor ($\cos\theta$)
0.86

<Trank Line 1>

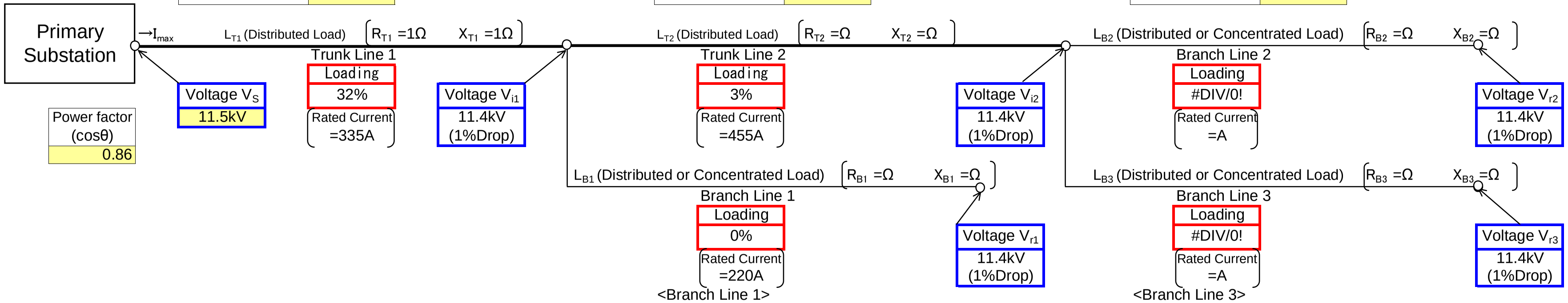
Load L_{T1}	96A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1845kVA	

<Trank Line 2>

Load L_{T2}	10A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	200kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

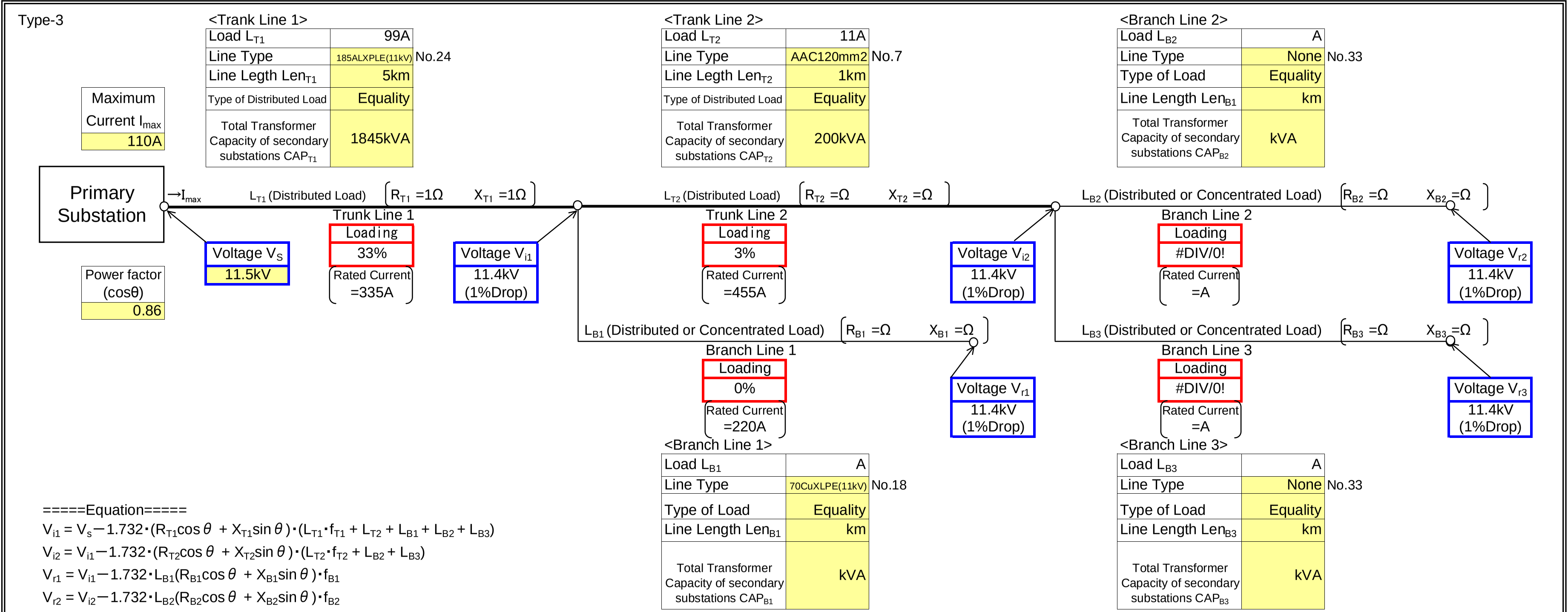
$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	$\cos\theta$	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 1

: Input data in colored cells



=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 1

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	103A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1845kVA	

<Trank Line 2>

Load L_{T2}	11A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	200kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}
114A

Primary Substation

Power factor (cosθ)
0.86

$\rightarrow I_{max}$

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)

Voltage V_S: 11.5kV

Trunk Line 1 — Loading 34% — Rated Current =335A

Voltage V_{i1}: 11.4kV (1%Drop)

L_{T2} (Distributed Load) (R_{T2} =Ω X_{T2} =Ω)

Trunk Line 2 — Loading 3% — Rated Current =455A

Voltage V_{i2}: 11.4kV (1%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2 — Loading #DIV/0! — Rated Current =A

Voltage V_{r2}: 11.4kV (1%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =Ω X_{B1} =Ω)

Branch Line 1 — Loading 0% — Rated Current =220A

Voltage V_{r1}: 11.4kV (1%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3 — Loading #DIV/0! — Rated Current =A

Voltage V_{r3}: 11.4kV (1%Drop)

<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
119A

Power factor (cosθ)
0.86

<Trank Line 1>

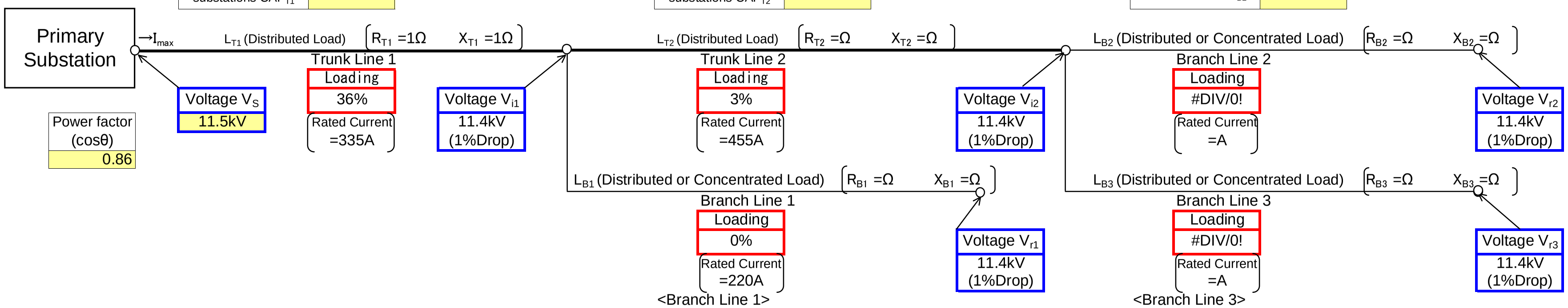
Load L_{T1}	107A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1845kVA	

<Trank Line 2>

Load L_{T2}	12A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	200kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A - *Power System Analysis for existing system using Macro demand forecast* -

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
123A

Power factor ($\cos\theta$)
0.86

<Trank Line 1>

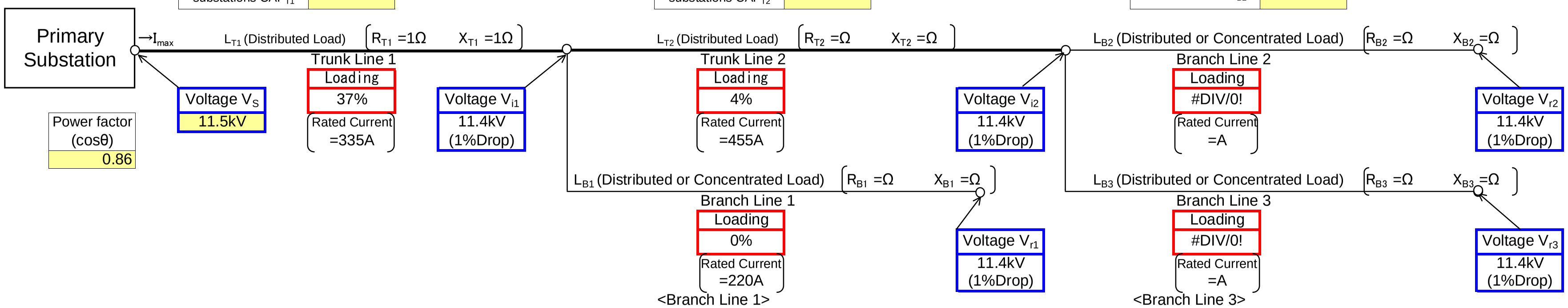
Load L_{T1}	111A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1845kVA	

<Trank Line 2>

Load L_{T2}	12A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	200kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage
V_{i1} : Interim Voltage
V_{i2} : Interim Voltage
V_{r1} : Received Voltage
V_{r2} : Received Voltage
V_{r3} : Received Voltage

I_{max} : Maximum Current
L_{T1} : Load (Trunk line 1)
L_{T2} : Load (Trunk line 2)
L_{B1} : Load (Branch Line 1)
L_{B2} : Load (Branch Line 2)
L_{B3} : Load (Branch Line 3)

R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3} : Resistance
X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3} : Reactance
f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3} : Dispersal Load Factor
CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
$\cos\theta$: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	cape coast B.S.P.
Feeder Name	TOWN 1

: Input data in colored cells

Type-3

Maximum Current I_{max}
128A

Power factor (cosθ)
0.86

<Trank Line 1>

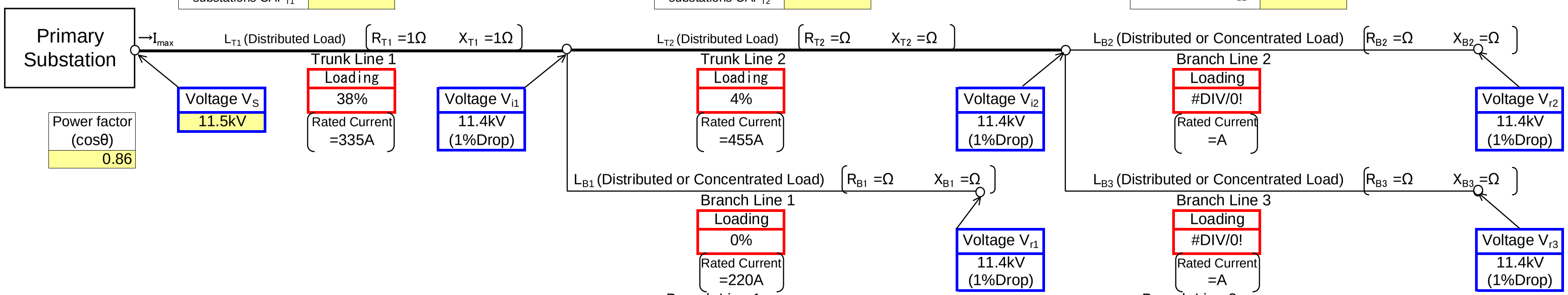
Load L_{T1}	115A	
Line Type	185ALXPLE(11kV)	No.24
Line Legth Len_{T1}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	1845kVA	

<Trank Line 2>

Load L_{T2}	13A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	1km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	200kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	A	
Line Type	70CuXLPE(11kV)	No.18
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B1}	kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	WINNEBA

: Input data in colored cells

Type-3

Maximum Current I_{max}
380A

Power factor (cosθ)
0.86

<Trank Line 1>

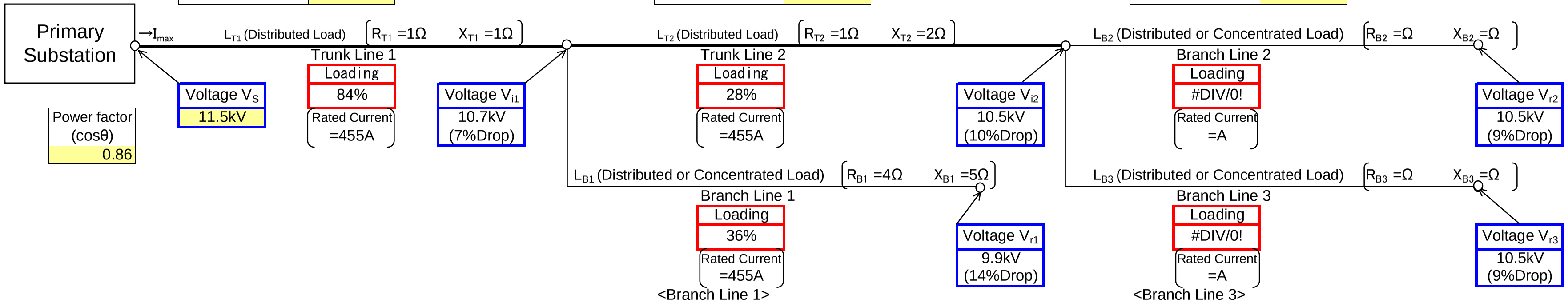
Load L_{T1}	87A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2015kVA	

<Trank Line 2>

Load L_{T2}	128A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2945kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	165A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	3815kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	WINNEBA

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	92A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2015kVA	

<Trank Line 2>

Load L_{T2}	135A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2945kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}	402A
Power factor (cosθ)	0.86

Primary Substation →I_{max}

Voltage V_S: 11.5kV

L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)
Trunk Line 1 — Loading 88% (Rated Current =455A)

Voltage V_{i1}: 10.7kV (7%Drop)

L_{T2} (Distributed Load) (R_{T2} =1Ω X_{T2} =2Ω)
Trunk Line 2 — Loading 30% (Rated Current =455A)

Voltage V_{i2}: 10.4kV (10%Drop)

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)
Branch Line 2 — Loading #DIV/0! (Rated Current =A)

Voltage V_{r2}: 10.4kV (9%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =4Ω X_{B1} =5Ω)
Branch Line 1 — Loading 38% (Rated Current =455A)

Voltage V_{r1}: 9.8kV (15%Drop)

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)
Branch Line 3 — Loading #DIV/0! (Rated Current =A)

Voltage V_{r3}: 10.4kV (9%Drop)

<Branch Line 1>

Load L_{B1}	175A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	3815kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	WINNEBA

: Input data in colored cells

Type-3

Maximum Current I_{max}
425A

Power factor (cosθ)
0.86

<Trank Line 1>

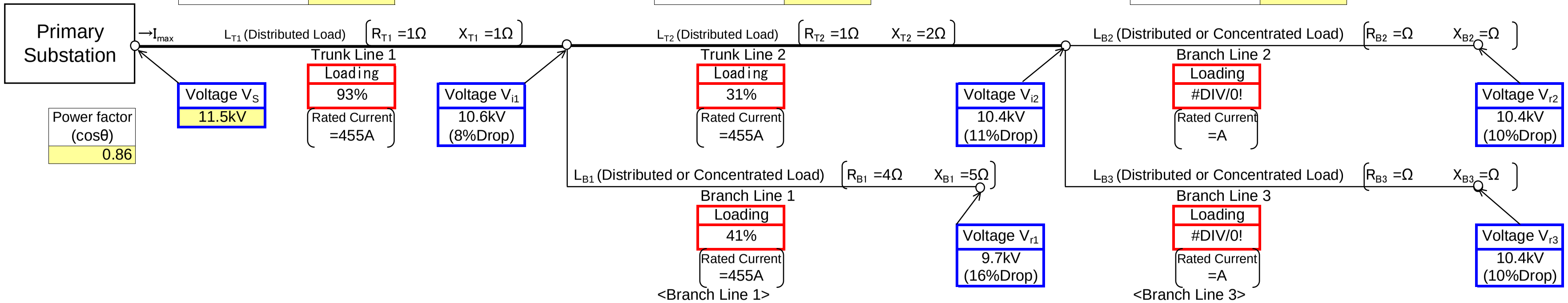
Load L_{T1}	98A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2015kVA	

<Trank Line 2>

Load L_{T2}	143A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2945kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	185A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	3815kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	WINNEBA

: Input data in colored cells

Type-3

Maximum Current I_{max}
450A

Power factor (cosθ)
0.86

<Trank Line 1>

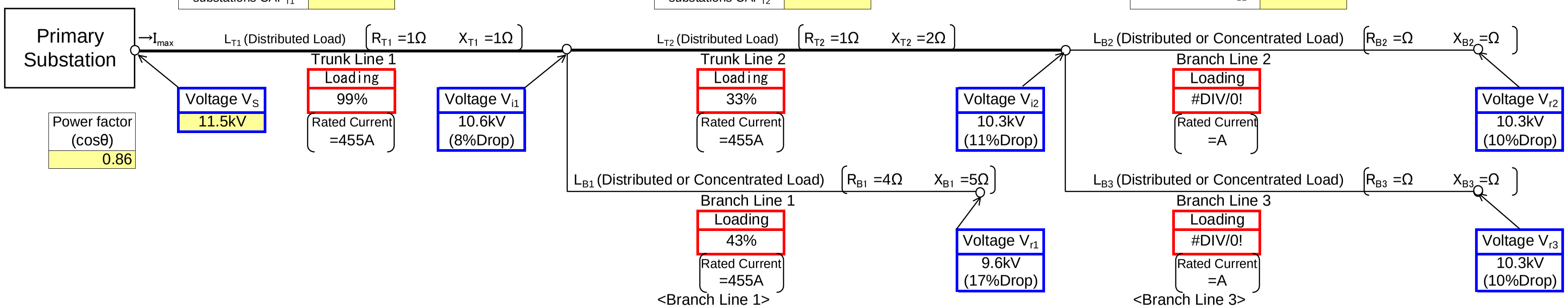
Load L_{T1}	103A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2015kVA	

<Trank Line 2>

Load L_{T2}	151A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2945kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	196A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	3815kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	WINNEBA

: Input data in colored cells

Type-3

<Trank Line 1>

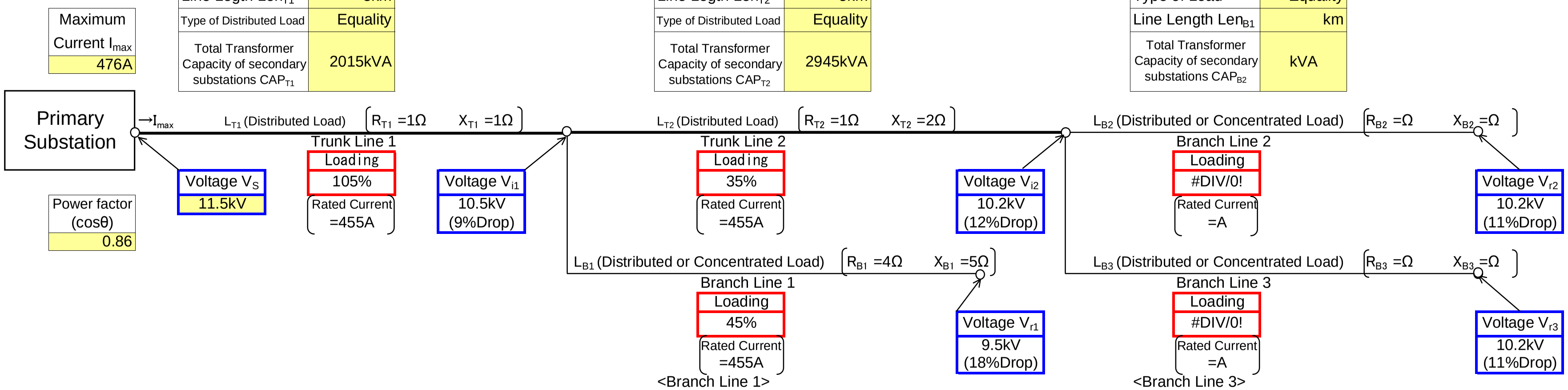
Load L_{T1}	109A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2015kVA	

<Trank Line 2>

Load L_{T2}	160A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2945kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	207A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	3815kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	WINNEBA

: Input data in colored cells

Type-3

Maximum Current I_{max}
504A

Power factor (cosθ)
0.86

<Trank Line 1>

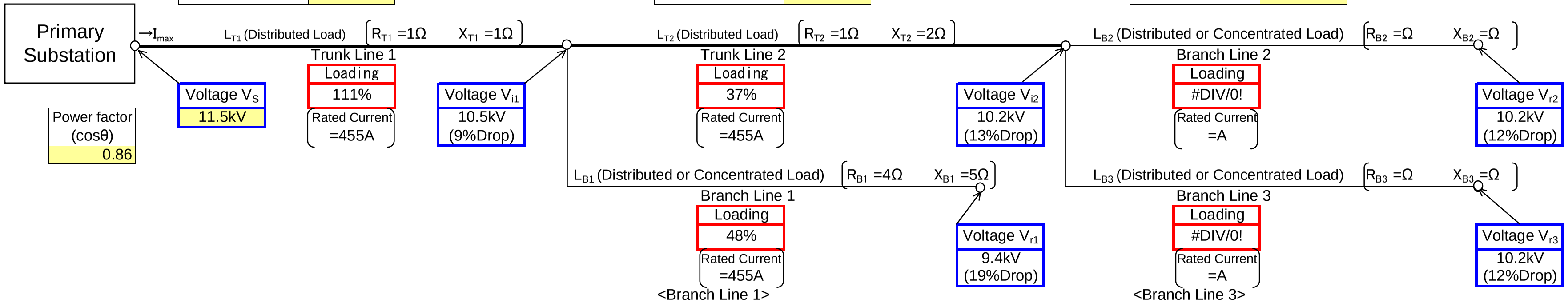
Load L_{T1}	116A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2015kVA	

<Trank Line 2>

Load L_{T2}	169A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2945kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	219A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	3815kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

- V_s : Supply Voltage
- V_{i1} : Interim Voltage
- V_{i2} : Interim Voltage
- V_{r1} : Received Voltage
- V_{r2} : Received Voltage
- V_{r3} : Received Voltage
- I_{max} : Maximum Current
- L_{T1} : Load (Trunk line 1)
- L_{T2} : Load (Trunk line 2)
- L_{B1} : Load (Branch Line 1)
- L_{B2} : Load (Branch Line 2)
- L_{B3} : Load (Branch Line 3)
- R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3} : Resistance
- X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3} : Reactance
- f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3} : Dispersal Load Factor
- CAP_{T1}, CAP_{T2}, CAP_{B1}, CAP_{B2}, CAP_{B3} : Total Transformer Capacity of secondary substations
- cosθ : Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	WINNEBA

: Input data in colored cells

Type-3

Maximum Current I_{max}
533A

Primary Substation

Power factor (cosθ)
0.86

Voltage V_s
11.5kV

<Trank Line 1>

Load L_{T1}	122A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2015kVA	

$\rightarrow I_{max}$ L_{T1} (Distributed Load) (R_{T1} =1Ω X_{T1} =1Ω)

Trunk Line 1
Loading
117%
Rated Current =455A

Voltage V_{i1}
10.4kV
(10%Drop)

<Trank Line 2>

Load L_{T2}	179A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2945kVA	

L_{T2} (Distributed Load) (R_{T2} =1Ω X_{T2} =2Ω)

Trunk Line 2
Loading
39%
Rated Current =455A

Voltage V_{i2}
10.1kV
(14%Drop)

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

L_{B2} (Distributed or Concentrated Load) (R_{B2} =Ω X_{B2} =Ω)

Branch Line 2
Loading
#DIV/0!
Rated Current =A

Voltage V_{r2}
10.1kV
(12%Drop)

L_{B1} (Distributed or Concentrated Load) (R_{B1} =4Ω X_{B1} =5Ω)

Branch Line 1
Loading
51%
Rated Current =455A

Voltage V_{r1}
9.2kV
(20%Drop)

<Branch Line 1>

Load L_{B1}	232A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	3815kVA	

L_{B3} (Distributed or Concentrated Load) (R_{B3} =Ω X_{B3} =Ω)

Branch Line 3
Loading
#DIV/0!
Rated Current =A

Voltage V_{r3}
10.1kV
(12%Drop)

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732\cdot(R_{T1}\cos\theta + X_{T1}\sin\theta)\cdot(L_{T1}\cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732\cdot(R_{T2}\cos\theta + X_{T2}\sin\theta)\cdot(L_{T2}\cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732\cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta)\cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732\cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta)\cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732\cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta)\cdot f_{B3}$

$L_{T1} = I_{max}\cdot CAP_{T1}/(CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max}\cdot CAP_{T2}/(CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max}\cdot CAP_{B1}/(CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max}\cdot CAP_{B2}/(CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max}\cdot CAP_{B3}/(CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	WINNEBA

: Input data in colored cells

Type-3

<Trank Line 1>

Load L_{T1}	130A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2015kVA	

<Trank Line 2>

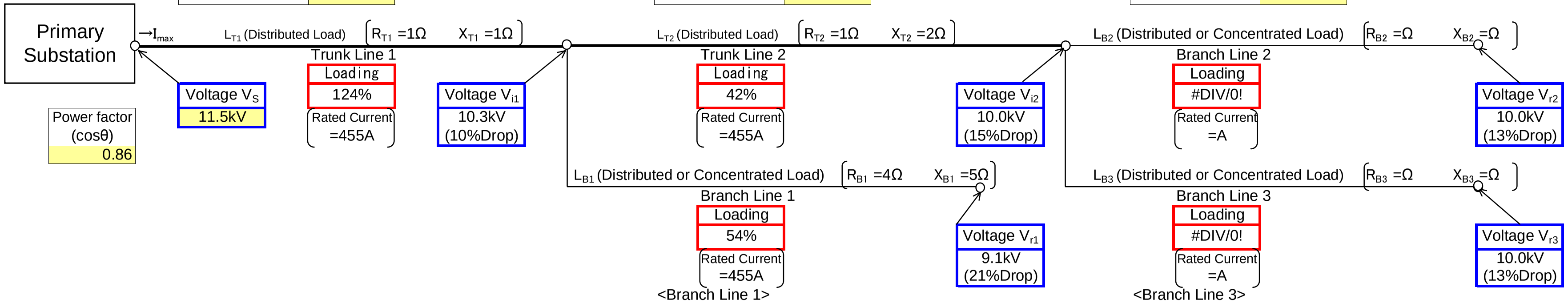
Load L_{T2}	189A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2945kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	

Maximum Current I_{max}
564A

Power factor (cosθ)
0.86



<Branch Line 1>

Load L_{B1}	245A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	3815kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	WINNEBA

: Input data in colored cells

Type-3

Maximum Current I_{max}
596A

Power factor ($\cos\theta$)
0.86

<Trank Line 1>

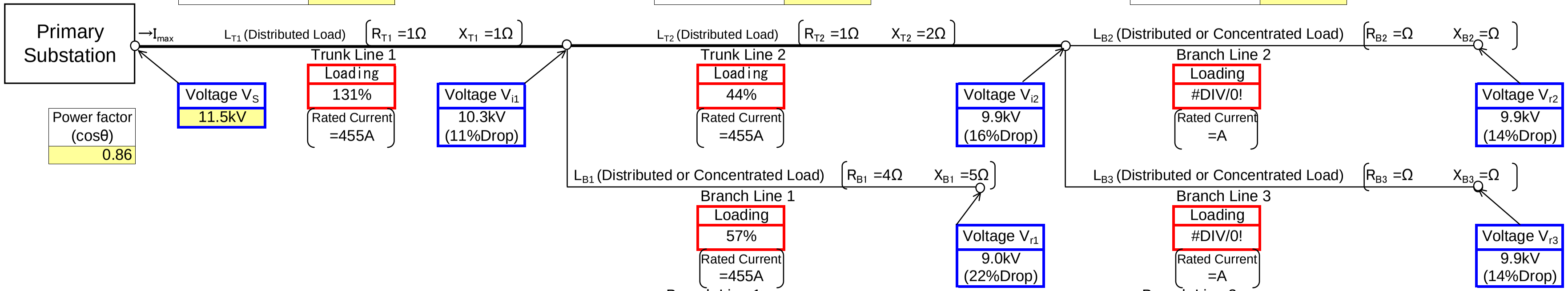
Load L_{T1}	137A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2015kVA	

<Trank Line 2>

Load L_{T2}	200A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2945kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	259A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	3815kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	$\cos\theta$	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	WINNEBA

: Input data in colored cells

Type-3

Maximum Current I_{max}
631A

Power factor (cosθ)
0.86

<Trank Line 1>

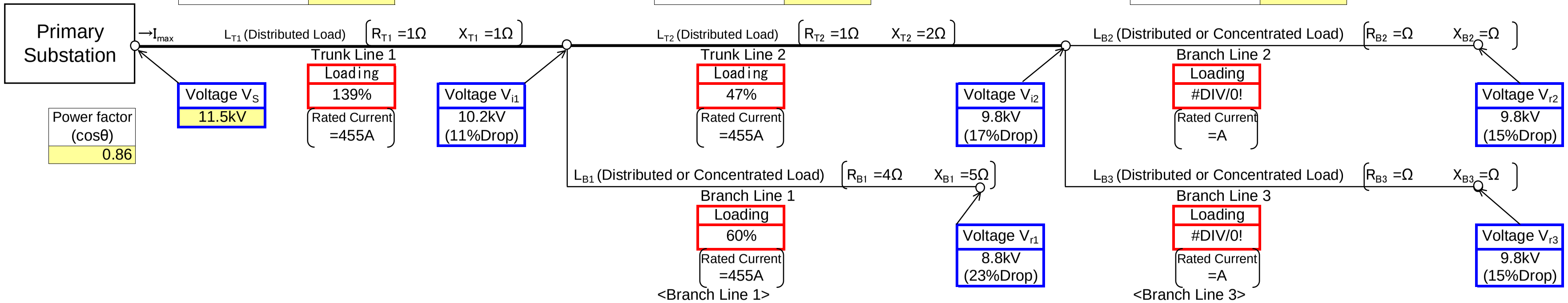
Load L_{T1}	145A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2015kVA	

<Trank Line 2>

Load L_{T2}	212A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2945kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	274A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	3815kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	CAP_{T1}, CAP_{T2}, CAP_{B1}	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	WINNEBA

: Input data in colored cells

Type-3

Maximum Current I_{max}
668A

<Trank Line 1>

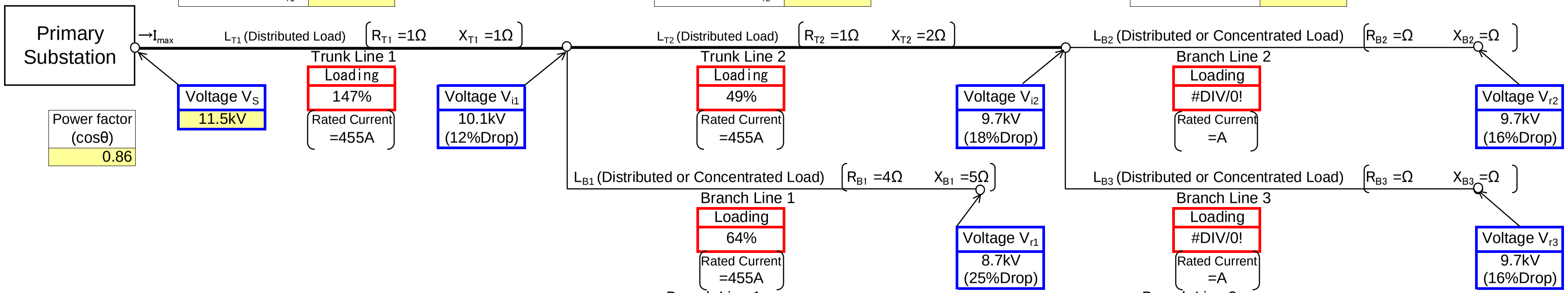
Load L_{T1}	153A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2015kVA	

<Trank Line 2>

Load L_{T2}	224A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2945kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	290A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	3815kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1} + CAP_{T2} + CAP_{B1} + CAP_{B2} + CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s : Supply Voltage	I_{max} : Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1} : Interim Voltage	L_{T1} : Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2} : Interim Voltage	L_{T2} : Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1} : Received Voltage	L_{B1} : Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2} : Received Voltage	L_{B2} : Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3} : Received Voltage	L_{B3} : Load (Branch Line 3)	cosθ	: Power Factor

Power System Analysis for Step A *- Power System Analysis for existing system using Macro demand forecast -*

Substation Name	WINNEBA B.S.P.
Feeder Name	WINNEBA

: Input data in colored cells

Type-3

Maximum Current I_{max}
706A

<Trank Line 1>

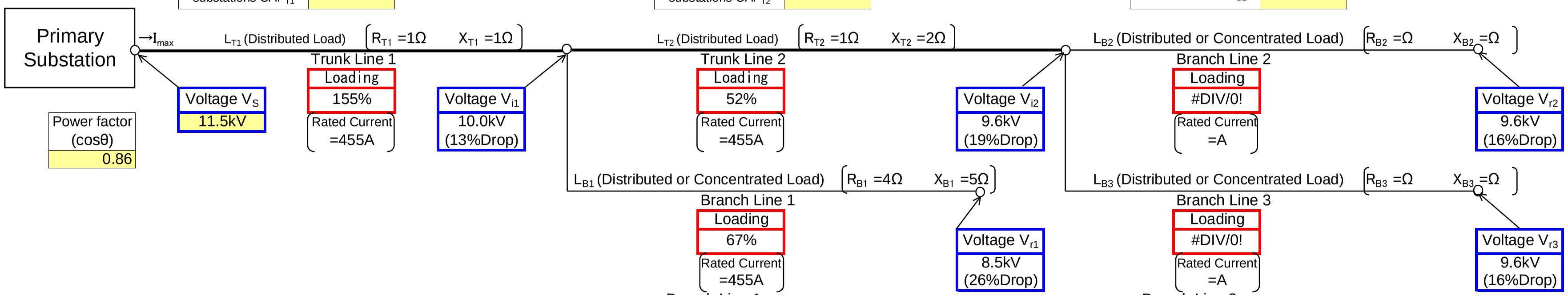
Load L_{T1}	162A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T1}	3km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T1}	2015kVA	

<Trank Line 2>

Load L_{T2}	237A	
Line Type	AAC120mm2	No.7
Line Legth Len_{T2}	5km	
Type of Distributed Load	Equality	
Total Transformer Capacity of secondary substations CAP_{T2}	2945kVA	

<Branch Line 2>

Load L_{B2}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B1}	km	
Total Transformer Capacity of secondary substations CAP_{B2}	kVA	



<Branch Line 1>

Load L_{B1}	307A	
Line Type	AAC120mm2	No.7
Type of Load	Equality	
Line Length Len_{B1}	14km	
Total Transformer Capacity of secondary substations CAP_{B1}	3815kVA	

<Branch Line 3>

Load L_{B3}	A	
Line Type	None	No.33
Type of Load	Equality	
Line Length Len_{B3}	km	
Total Transformer Capacity of secondary substations CAP_{B3}	kVA	

=====Equation=====

$V_{i1} = V_s - 1.732 \cdot (R_{T1}\cos\theta + X_{T1}\sin\theta) \cdot (L_{T1} \cdot f_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3})$

$V_{i2} = V_{i1} - 1.732 \cdot (R_{T2}\cos\theta + X_{T2}\sin\theta) \cdot (L_{T2} \cdot f_{T2} + L_{B2} + L_{B3})$

$V_{r1} = V_{i1} - 1.732 \cdot L_{B1}(R_{B1}\cos\theta + X_{B1}\sin\theta) \cdot f_{B1}$

$V_{r2} = V_{i2} - 1.732 \cdot L_{B2}(R_{B2}\cos\theta + X_{B2}\sin\theta) \cdot f_{B2}$

$V_{r3} = V_{i2} - 1.732 \cdot L_{B3}(R_{B3}\cos\theta + X_{B3}\sin\theta) \cdot f_{B3}$

$L_{T1} = I_{max} \cdot CAP_{T1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{T2} = I_{max} \cdot CAP_{T2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B1} = I_{max} \cdot CAP_{B1} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B2} = I_{max} \cdot CAP_{B2} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$L_{B3} = I_{max} \cdot CAP_{B3} / (CAP_{T1}+CAP_{T2}+CAP_{B1}+CAP_{B2}+CAP_{B3})$

$I_{max} = L_{T1} + L_{T2} + L_{B1} + L_{B2} + L_{B3}$

V_s	: Supply Voltage	I_{max}	: Maximum Current	$R_{T1}, R_{T2}, R_{B1}, R_{B2}, R_{B3}$	: Resistance
V_{i1}	: Interim Voltage	L_{T1}	: Load (Trunk line 1)	$X_{T1}, X_{T2}, X_{B1}, X_{B2}, X_{B3}$	: Reactance
V_{i2}	: Interim Voltage	L_{T2}	: Load (Trunk line 2)	$f_{T1}, f_{T2}, f_{B1}, f_{B2}, f_{B3}$	: Dispersal Load Factor
V_{r1}	: Received Voltage	L_{B1}	: Load (Branch Line 1)	$CAP_{T1}, CAP_{T2}, CAP_{B1}$	: Total Transformer Capacity of secondary substations
V_{r2}	: Received Voltage	L_{B2}	: Load (Branch Line 2)	CAP_{B2}, CAP_{B3}	
V_{r3}	: Received Voltage	L_{B3}	: Load (Branch Line 3)	cosθ	: Power Factor