Transmission usage cost and loss allocation using AP and MP-AP Method

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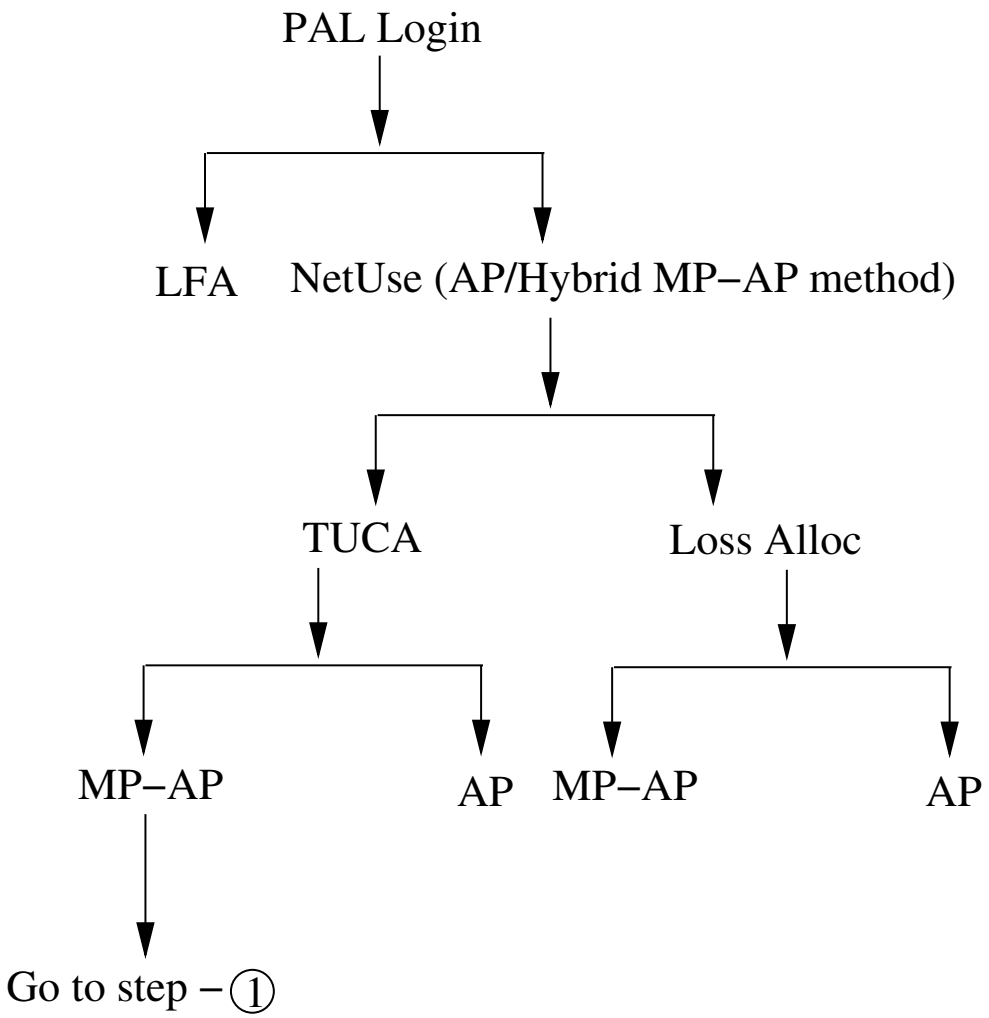
Outline


PAL Login
LFA
NetUse (AP/Hybrid MP−AP method)
TUCA
Loss Alloc
MP−AP
AP
MP−AP
AP
Go to step − ①

1. Run Load FLow
2. Run AP method (Proportionate Tracing)
   - 2.1 Generation Tracing – compute dispersed Slack Bus Factors for Load
   - 2.2 Load Tracing –compute dispersed Slack Bus Factors for Generator
3. Run MP method
   - 3.1 Perturb each load one at a time by 1 MW
   - 3.2 Specify paticipation factors for each generator to absorb this l oad + marginal losses
     Run load flow modelling dispersed slack bus calculate marginal flow vector.
   - 3.3 Perturb each generator one at a time by 1 MW
   - 3.4 Perturb each load to absorb this generation – marginal losses in
     Run load flow modelling dispersed slack bus calculate marginal flow vector.
   - 3.5 Calculate Marginal FLow Matrix
   - 3.6 Calculate Weighted Marginal Flow Matrix
   - 3.7 Neglect the counter flow values
   - 3.8 Calculate usage cost allocation for each line
     Normalize each column of the matrix and multiply the column with the line usage cost
   - 3.9 Calculate the total usage cost for each entity and determine the PoC
     of AC network

4. Sequentially simulate w/o scenarios for HVDC lines as follows: for each entity

   4.1 Calculate new usage cost entity wise of A.C system repeat steps 1 – 3.9

   4.2 Calculate incremental usage cost in the without scenario (ΔUi) for each entity

   4.3 Set negative values to zero and normalize incremental usage cost vector (dimension of Ne)

$$\alpha_i = \frac{\Delta Ui}{\Sigma \Delta Ui} \quad i=1 \cdots\cdots Ne$$

   4.4 Allocate HVDC line uage cost as per nomalized factors
   cost of usage of HVDC line for each entity=
   α_i X HVDCLineUsageCost

5. Entity usage cost of AC–DC network = uasge cost of AC network+ usage cost of each HVDC line
   PoC of entity=usagecost /MW scheduled

Run Loss Allocation

- Repeat steps (1) and (2)
- (3) Run MP method
  - (3.1) Perturb each load one at a time by 1 MW
  - (3.2) Specify paticipation factors for each generator to absorb this l oad + marginal losses
    Run Load flow modelling dispersed slack bus and calculate the change in the system loss (kli)
  - (3.3) Perturb each generator one at a time by 1 MW
  - (3.4) Perturb each load to absorb this generation − marginal losses in
    Run Load flow modelling dispersed slack bus and calculate the change in the system loss (kgi)
  - (3.5) Calculate a vector (V) by Weighting kgi and kli by the respective mw scheduled
  - (3.6) Calculate loss allocation factor of entity i (LAFi) = Vi/ ΣV
  - (3.7) Loss allocation of entity i = LAFi X systemloss

Five + Two system

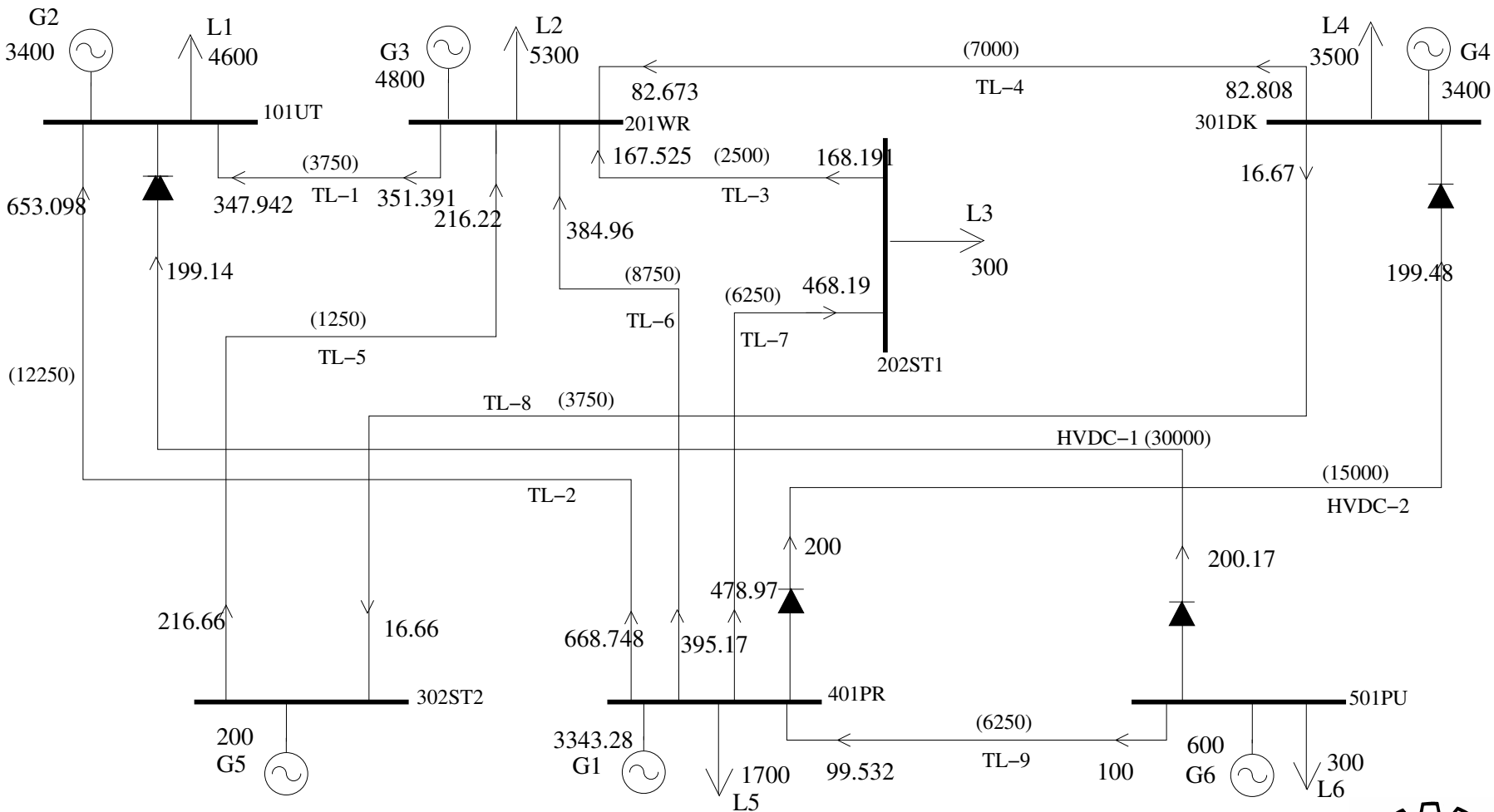


Figure: Five + Two Basic system

Generation Tracing

Starts from the pure source (501PU)

Delete the pure source node, model its contributions to the receipent nodes with generator tags

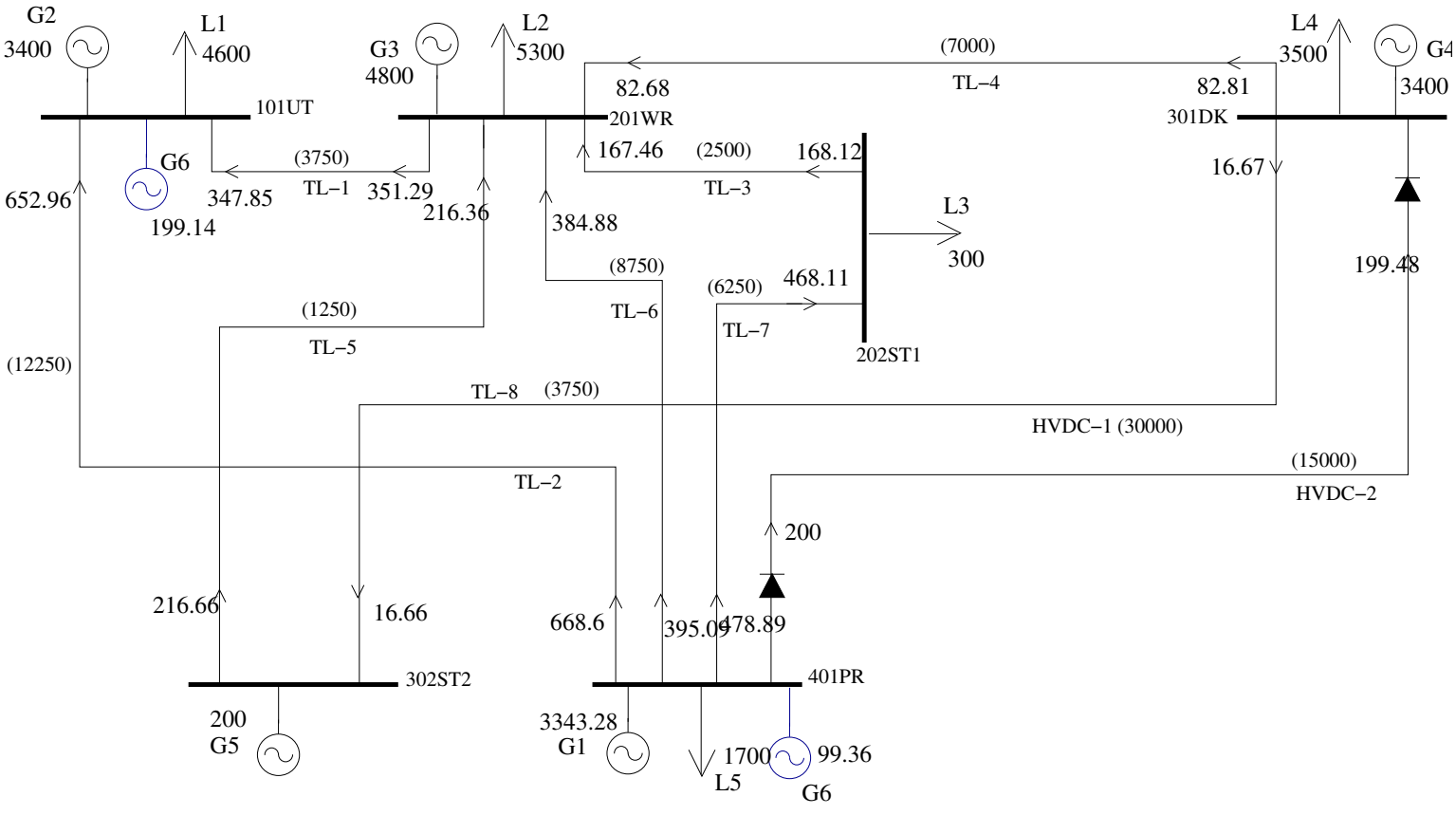


Figure: Elimination of node 501PU

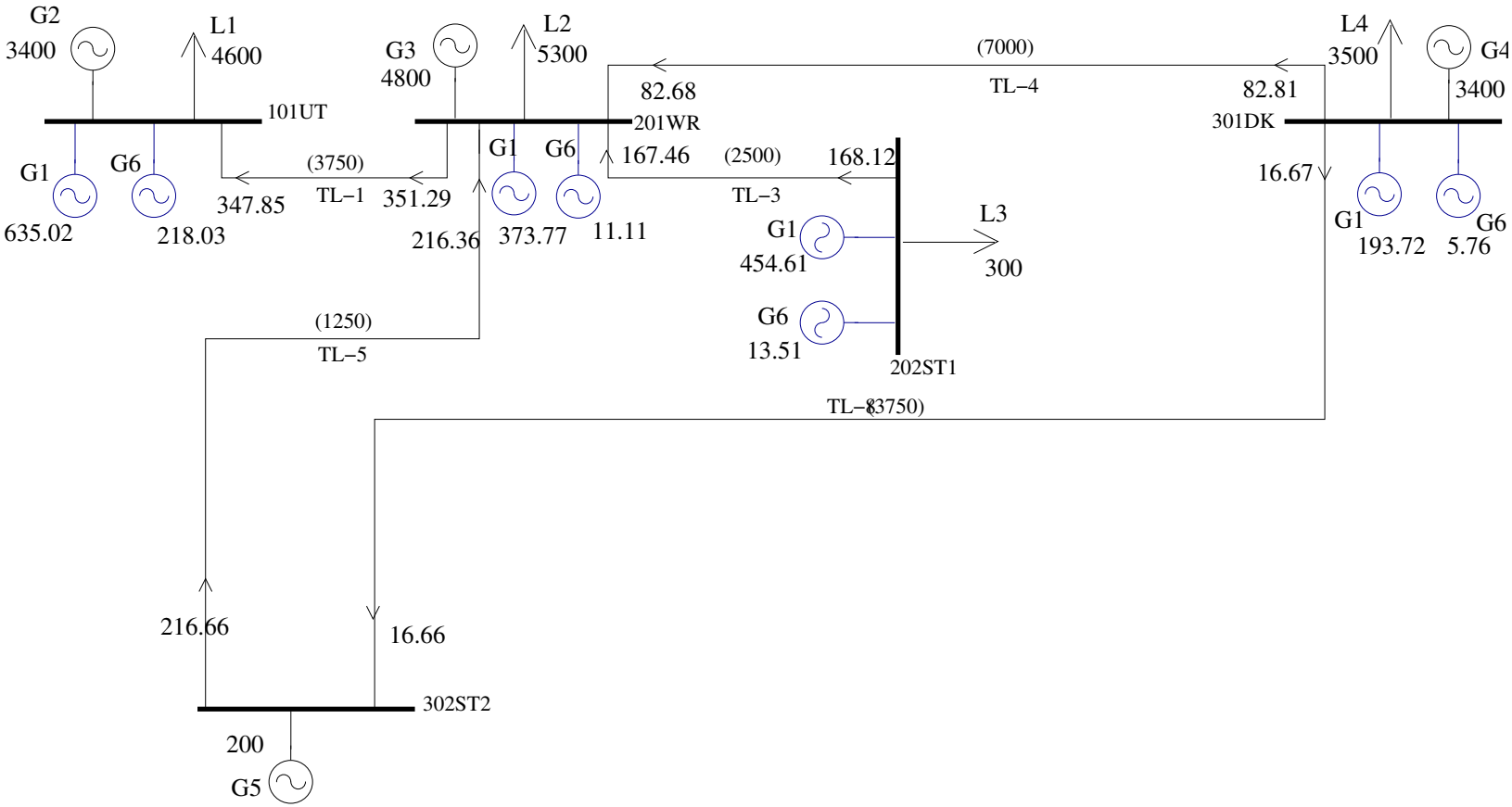


Figure: Elimination of node 401PR

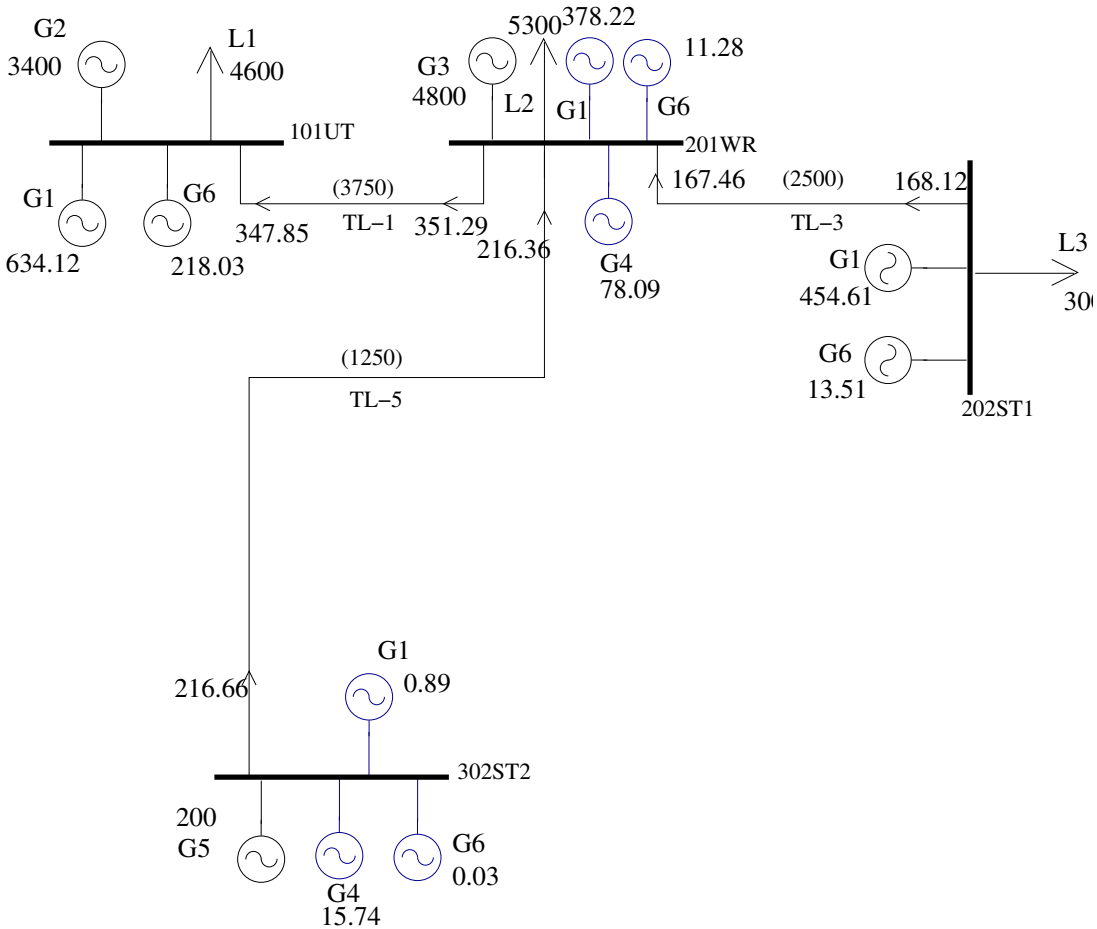


Figure: Elimination of node 301DK

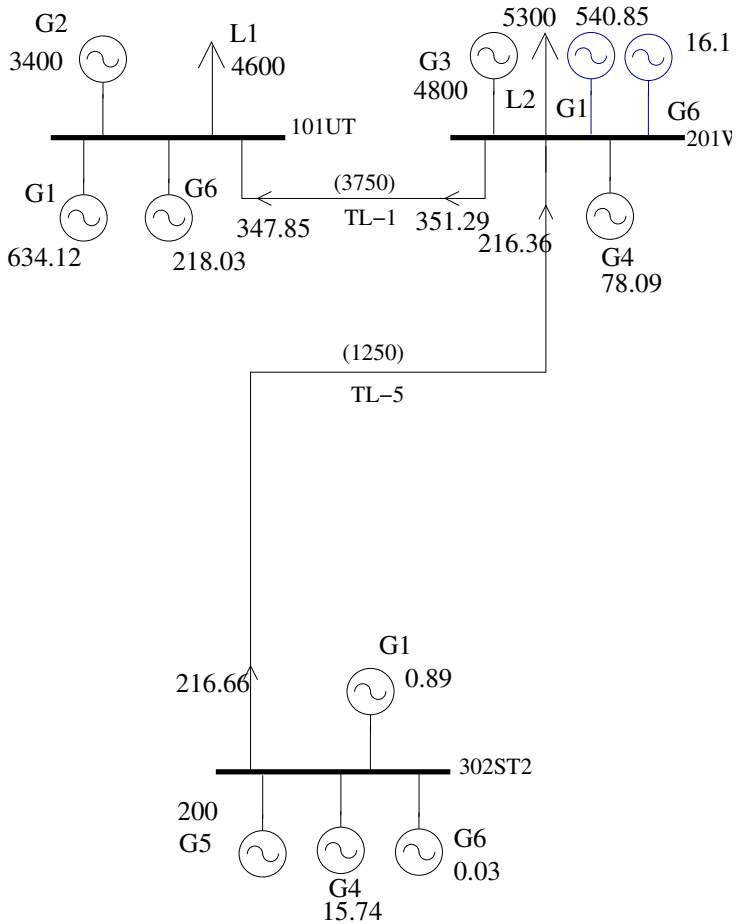


Figure: Elimination of node 202ST1

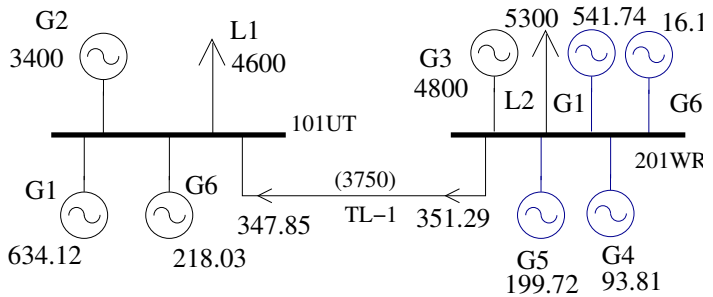


Figure: Elimination of node 302ST2

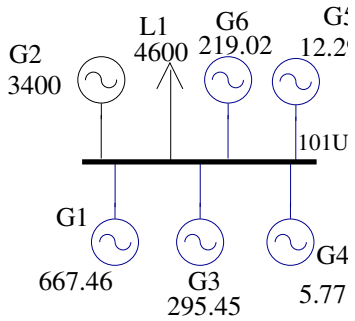


Figure: Elimination of node 201WR

Generation Tracing Results

	L1(4600) 101UT	L2(5300) 201WR	L3(300) 202ST1	L4(3500) 301DK	L5(1700) 401PR	L6(300) 501PU
G1(3343.47) 401PR	667.46	508.05	291.34	188.38	1650.94	
G2(3400) 101UT	3400					
G3(4800) 201WR	295.45	4501.54				
G4(3400) 301Dk	5.77	87.98		3306.01		
G5(200) 302ST2	12.29	187.29		0		
G6(600) 501PU	219.02	15.14	8.66	5.61	49.06	300
Sum	4600	5300	300	3500	1700	300

	G1	G2	G3	G4	G5	G6	Sum
L1	0.145	0.739	0.064	0.001	0.003	0.048	1
L2	0.096	0.000	0.849	0.017	0.035	0.003	1
L3	0.971	0.000	0.000	0.000	0.000	0.029	1
L4	0.054	0.000	0.000	0.945	0.000	0.002	1
L5	0.971	0.000	0.000	0.000	0.000	0.029	1
L6	0.000	0.000	0.000	0.000	0.000	1.000	1

Five + Two system

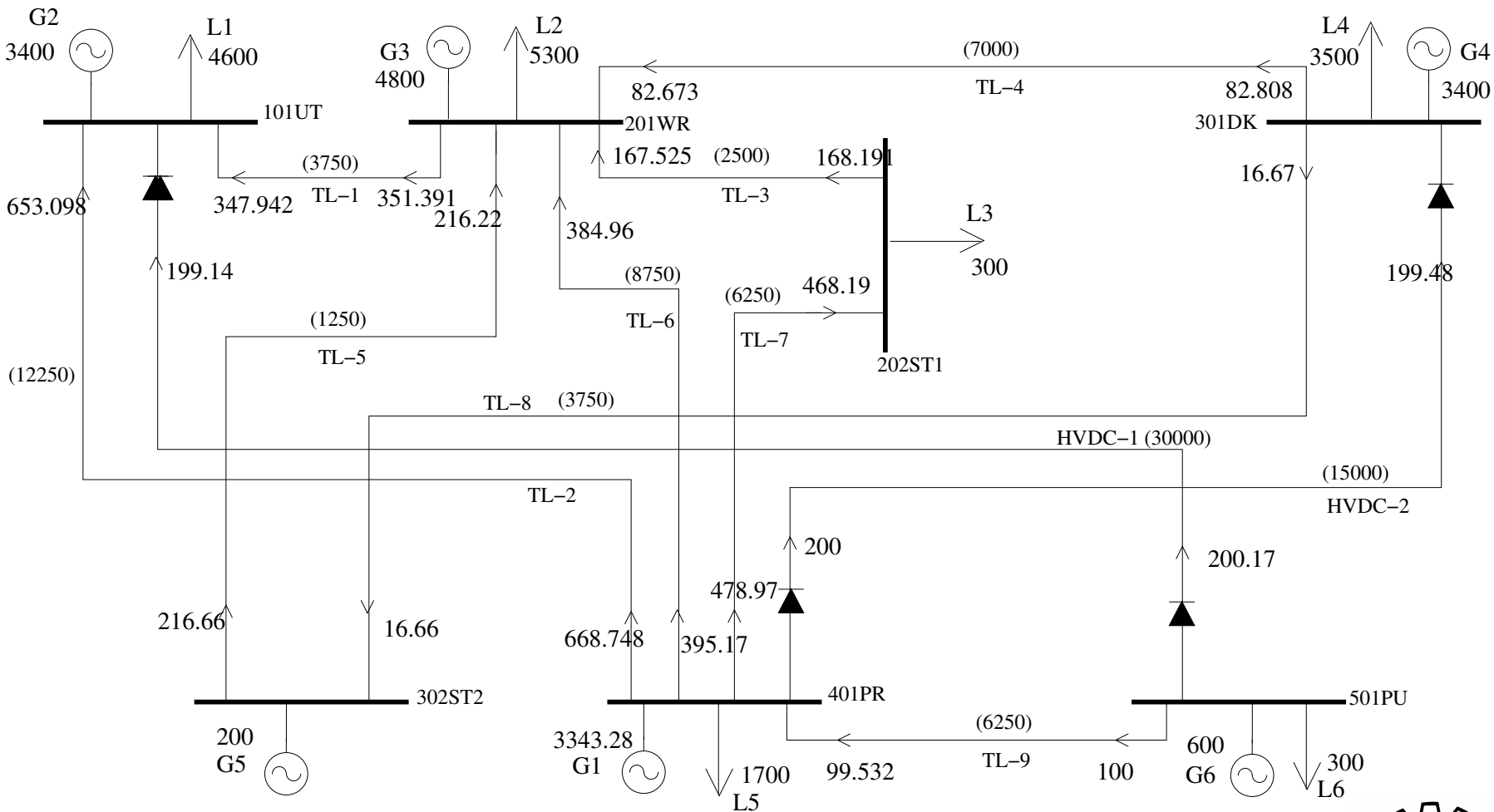


Figure: Five + Two Basic system

Load Tracing

Starts from the pure sink 101UT

Delete the pure sink node, model its contributions to the sender nodes with its load tags

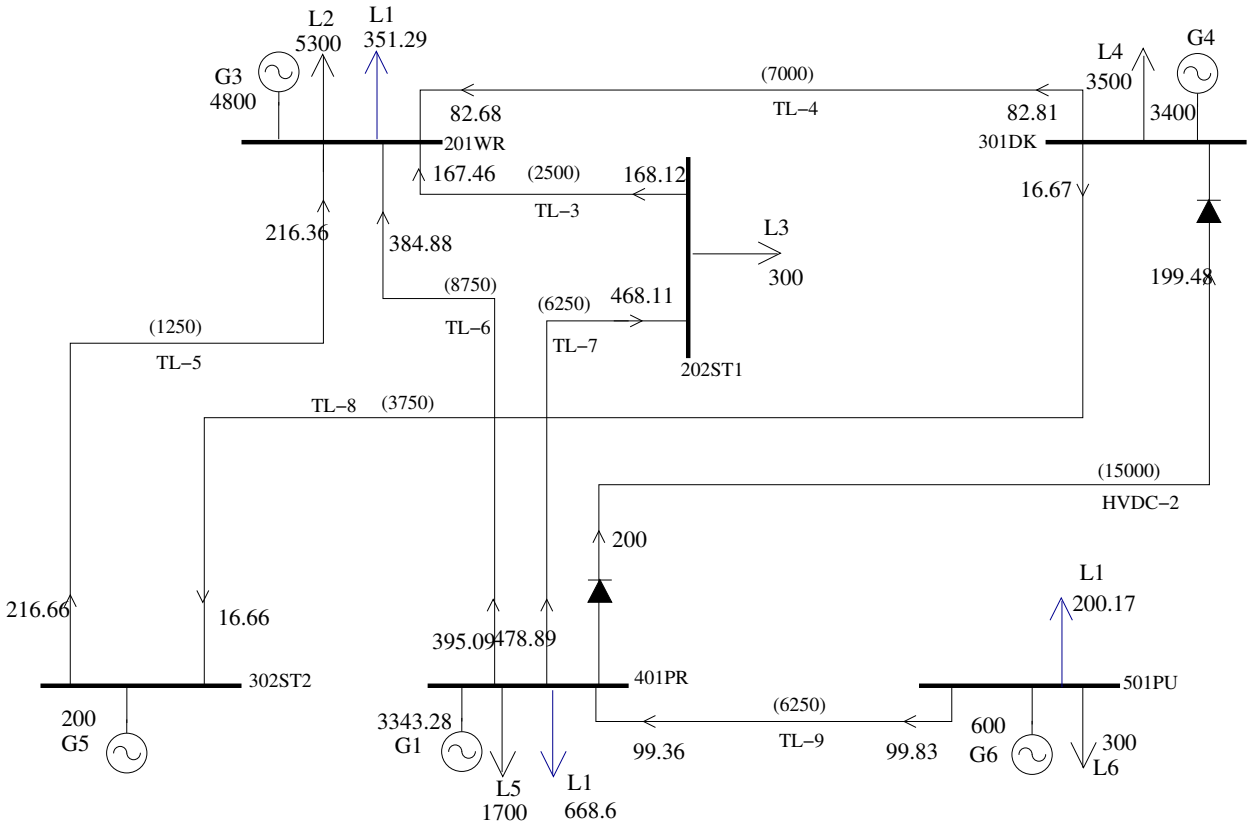


Figure: Elimination of node 101UT

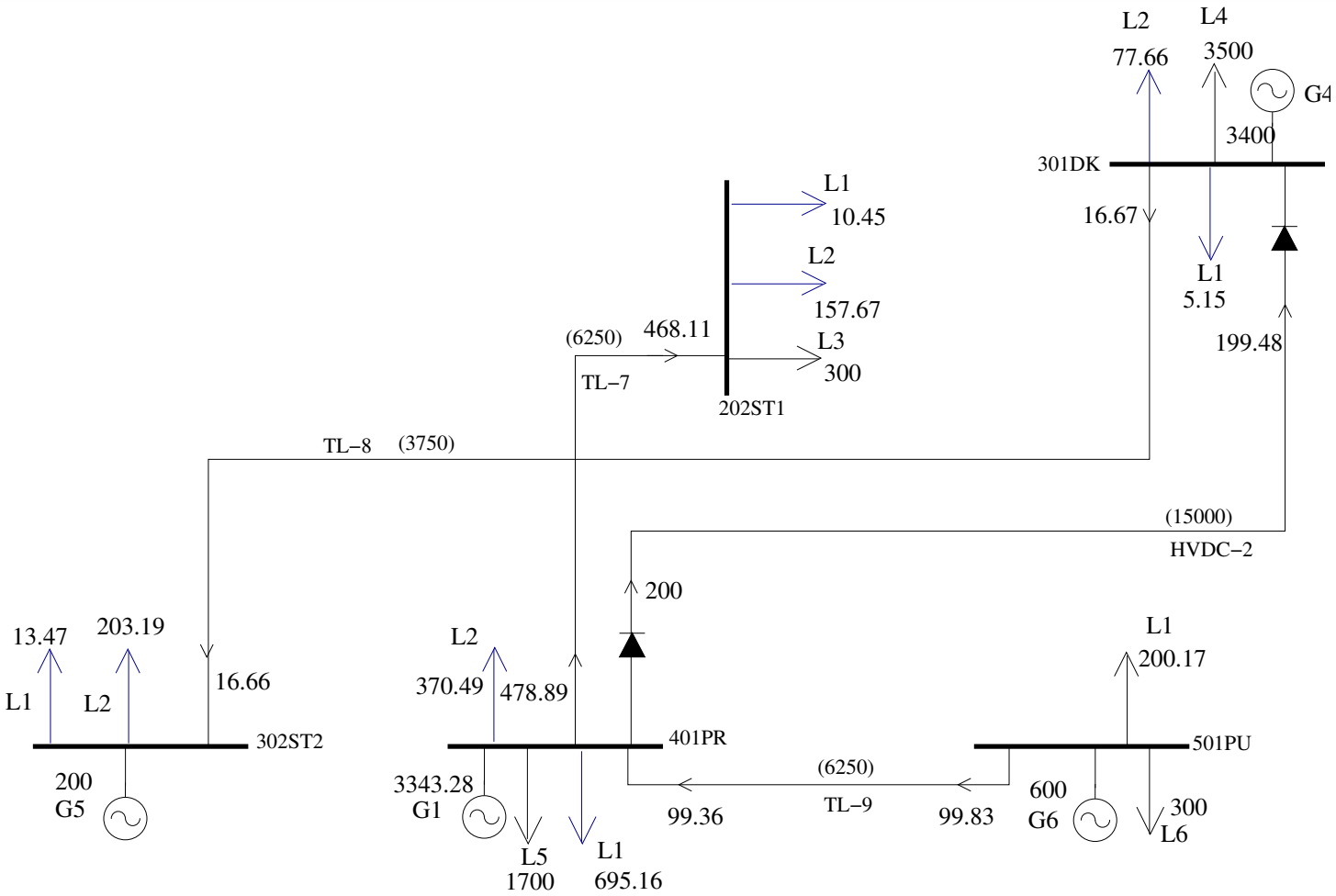


Figure: Elimination of node 201WR

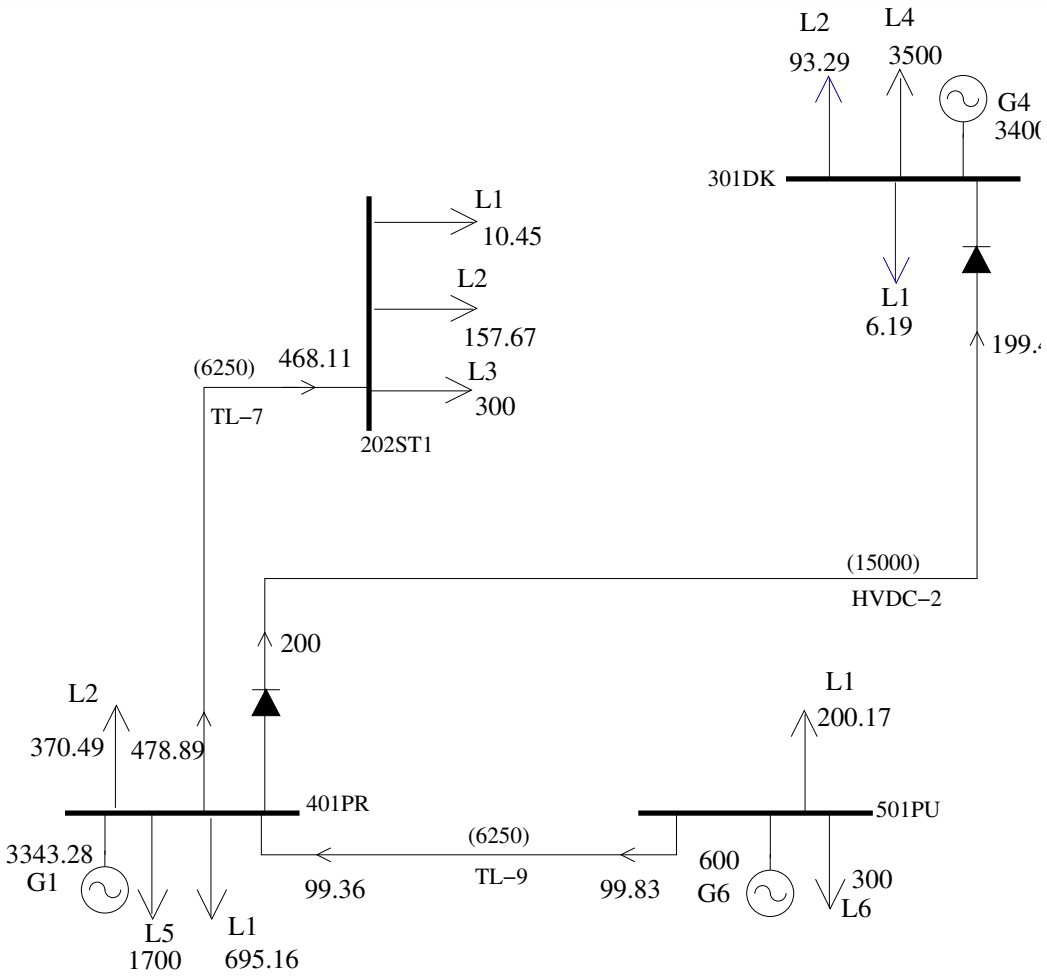


Figure: Elimination of node 302ST2

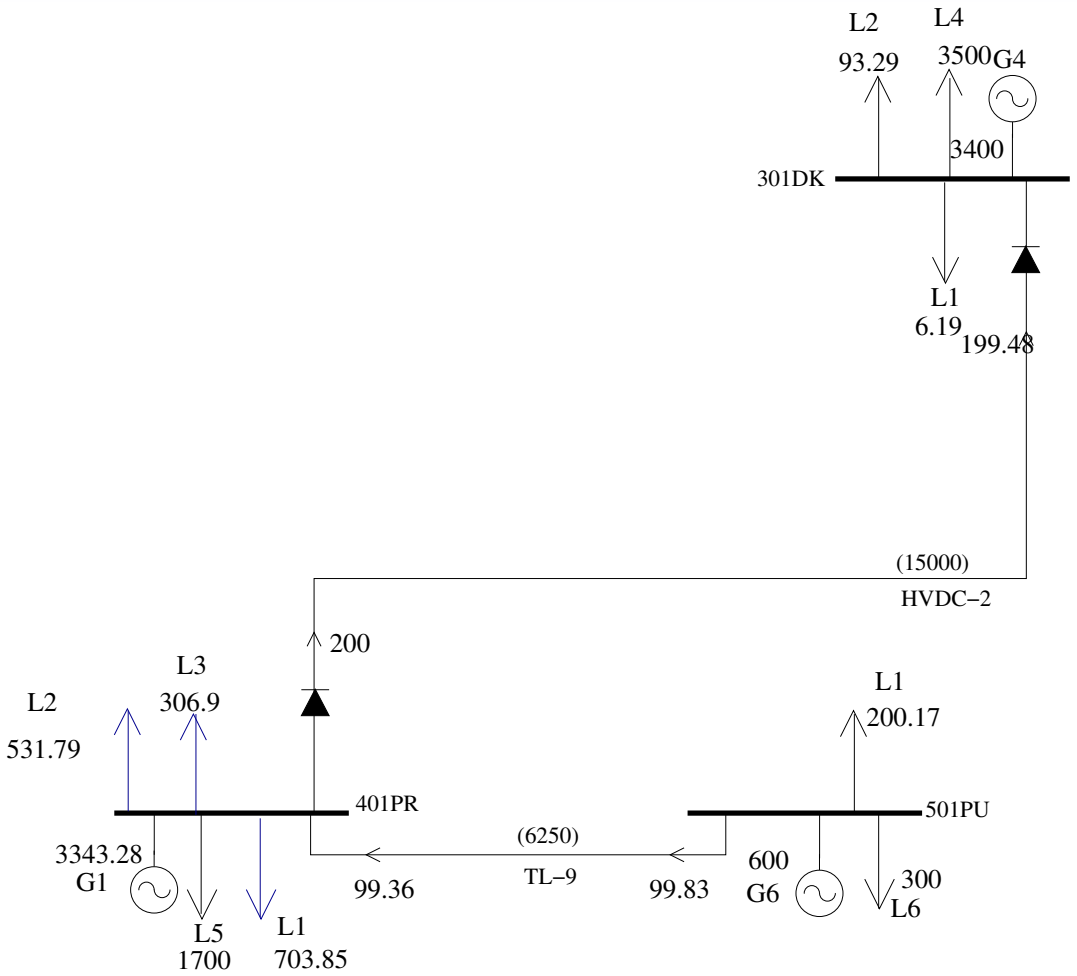


Figure: Elimination of node 202ST1

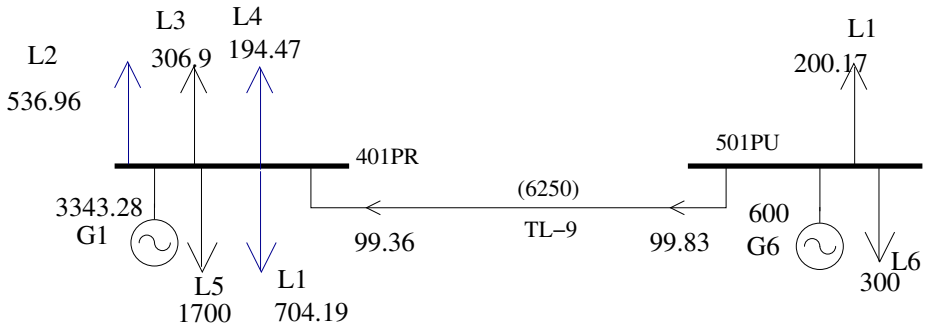


Figure: Elimination of node 301DK

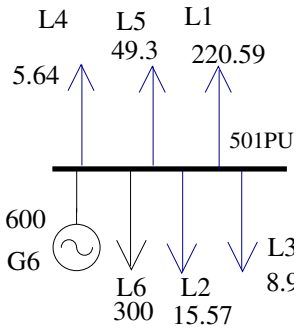


Figure: Elimination of node 401PR

Load tracing Results

	G1(3343.47)	G2(3400)	G3(4800)	G4(3400)	G5(200)	G6(600)
	401PR	101UT	201WR	301DK	302ST2	501PU
L1(4600) 101UT	683.94	3400	298.37	5.85	12.43	220.59
L2(5300) 201WR	521.48		4501.63	88.12	187.57	15.57
L3(300) 202ST1	298.04					8.9
L4(3500) 301DK	188.88			3306.03		5.64
L5(1700) 401PR	1650.94					49.3
L6(300) 501PU						300
	3343.47	3400	4800	3400	200	600

	L1	L2	L3	L4	L5	L6	Sum
G1	0.205	0.156	0.089	0.056	0.494	0.000	1
G2	1.000	0.000	0.000	0.000	0.000	0.000	1
G3	0.062	0.938	0.000	0.000	0.000	0.000	1
G4	0.002	0.026	0.000	0.972	0.000	0.000	1
G5	0.062	0.938	0.000	0.000	0.000	0.000	1
G6	0.368	0.026	0.015	0.009	0.082	0.500	1

Perturbation with G1

	L1	L2	L3	L4	L5	L6
G1	0.202	0.154	0.088	0.057	0.499	0.000

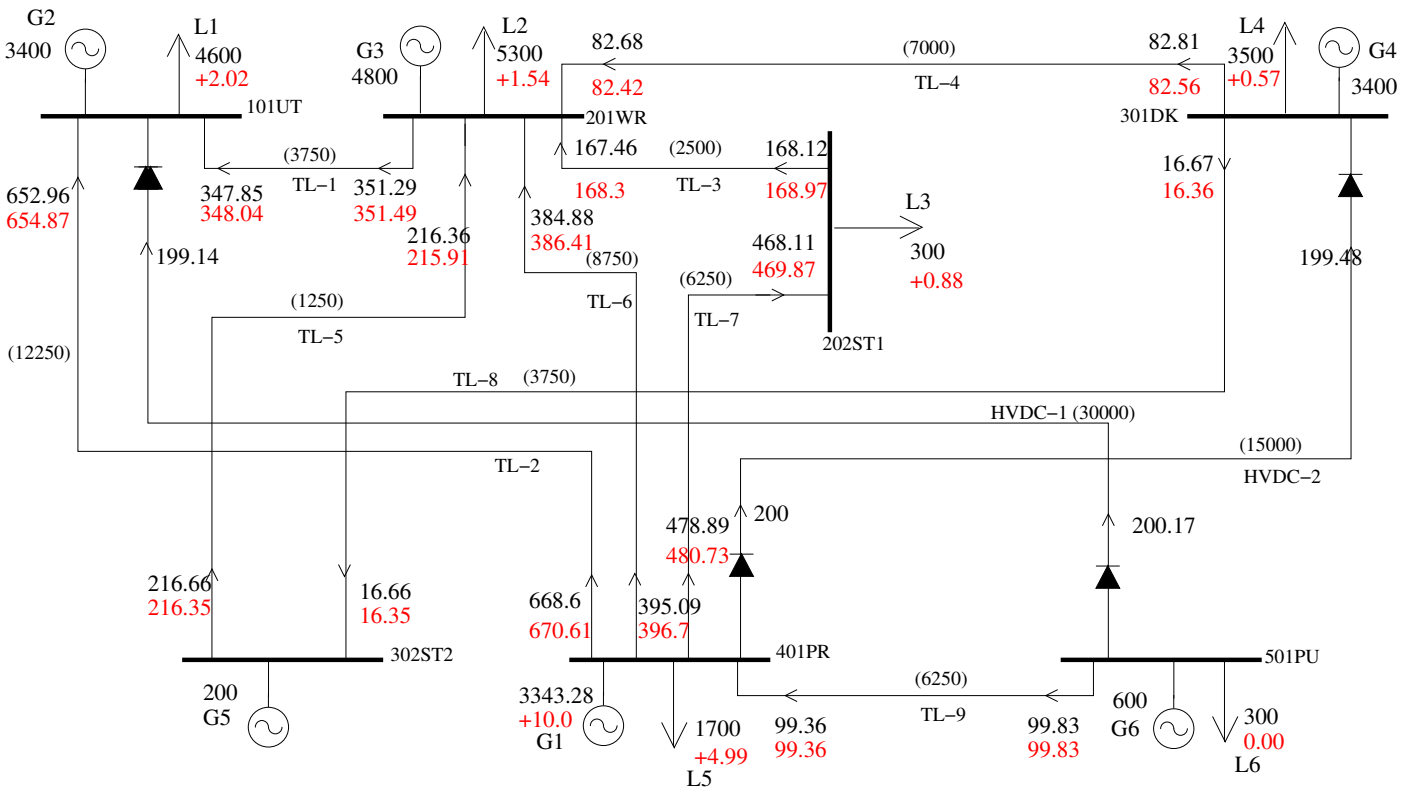


Figure: Perturbation of G1

Marginal Flow Vector:

Entity	Psch	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
G1	3343.37	0.018	0.196	0.083	-0.031	-0.025	0.157	0.180	-0.025	0.000

Perturbation with G2

	L1	L2	L3	L4	L5	L6
G2	1.000	0.000	0.000	0.000	0.000	0.000

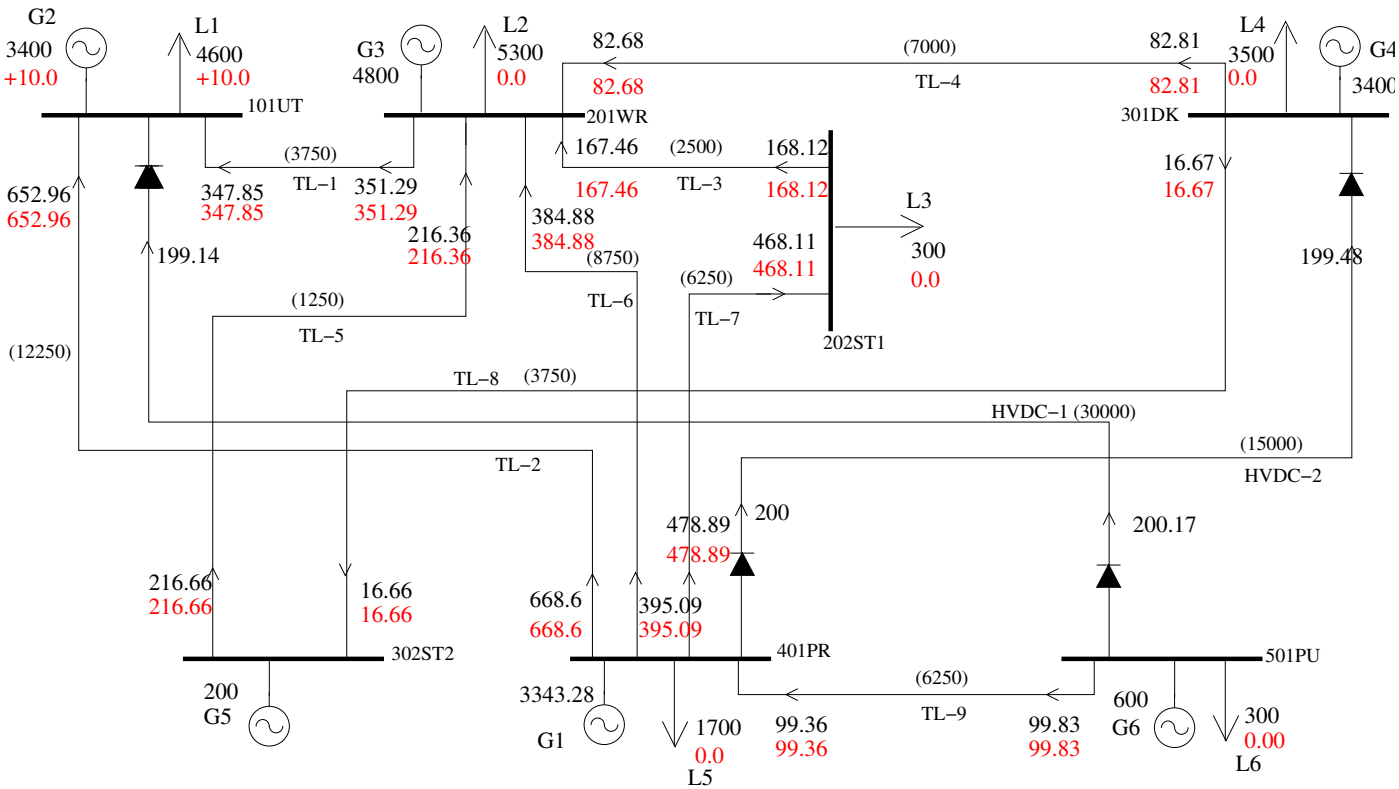


Figure: Perturbation of G2

Marginal Flow Vector:

Entity	Psch	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
G2	3400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Perturbation with G3

	L1	L2	L3	L4	L5	L6
G3	0.062	0.938	0.000	0.000	0.000	0.000

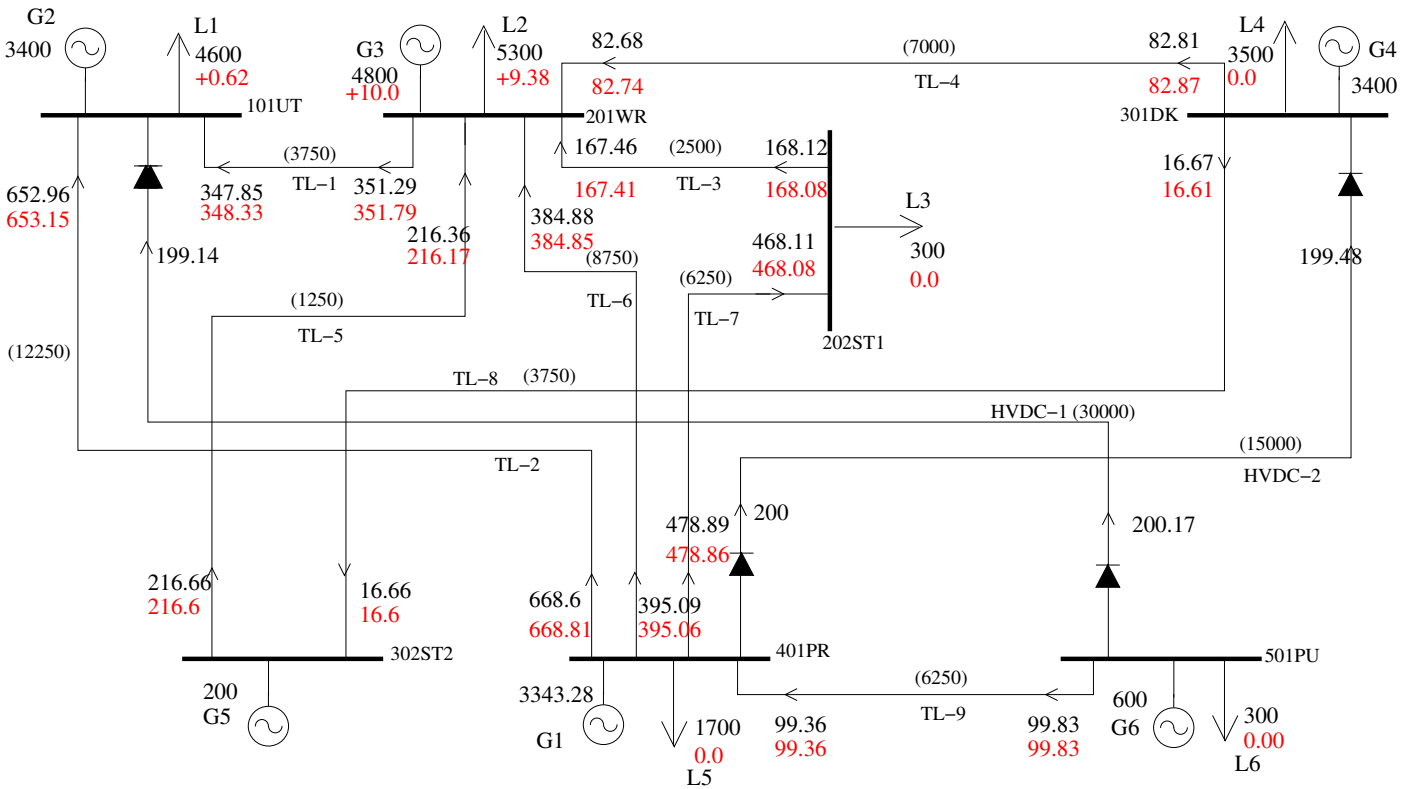


Figure: Perturbation of G3

Marginal Flow Vector:

Entity	Psch	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
G3	4800	0.048	0.016	-0.007	0.000	0.000	-0.007	-0.007	0.000	0.000

Perturbation with G4

	L1	L2	L3	L4	L5	L6
G4	0.002	0.026	0.000	0.972	0.000	0.000

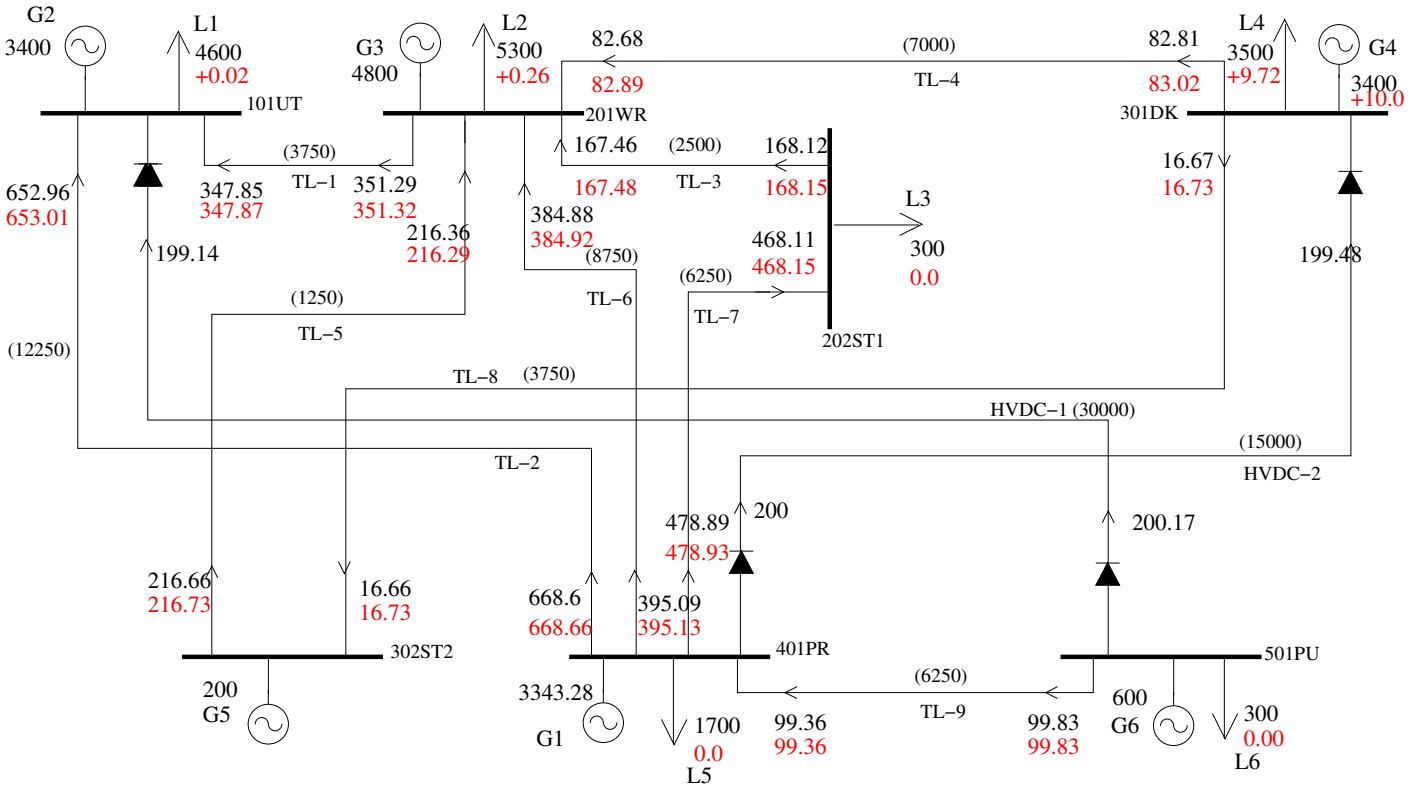


Figure: Perturbation of G4

Marginal Flow Vector:

Entity	Psch	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
G4	3400	0.001	0.000	0.000	0.015	0.012	0.000	0.000	0.012	0.000

Perturbation with G5

	L1	L2	L3	L4	L5	L6
G5	0.062	0.938	0.000	0.000	0.000	0.000

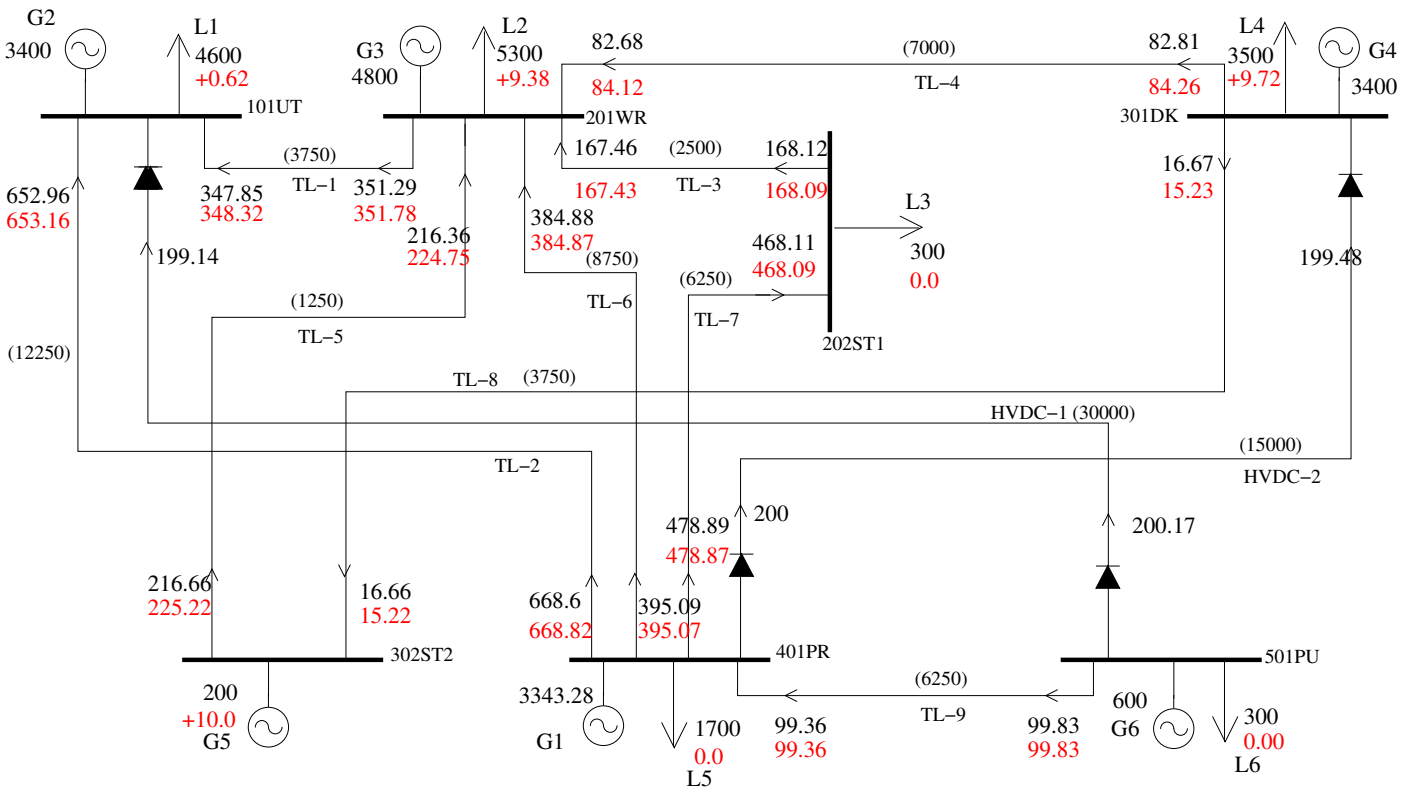


Figure: Perturbation of G5

Marginal Flow Vector:

Entity	Psch	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
G5	200	0.047	0.017	-0.006	0.138	0.862	-0.006	-0.006	-0.138	0.000

Perturbation with G6

	L1	L2	L3	L4	L5	L6
G6	0.367	0.025	0.014	0.009	0.082	0.502

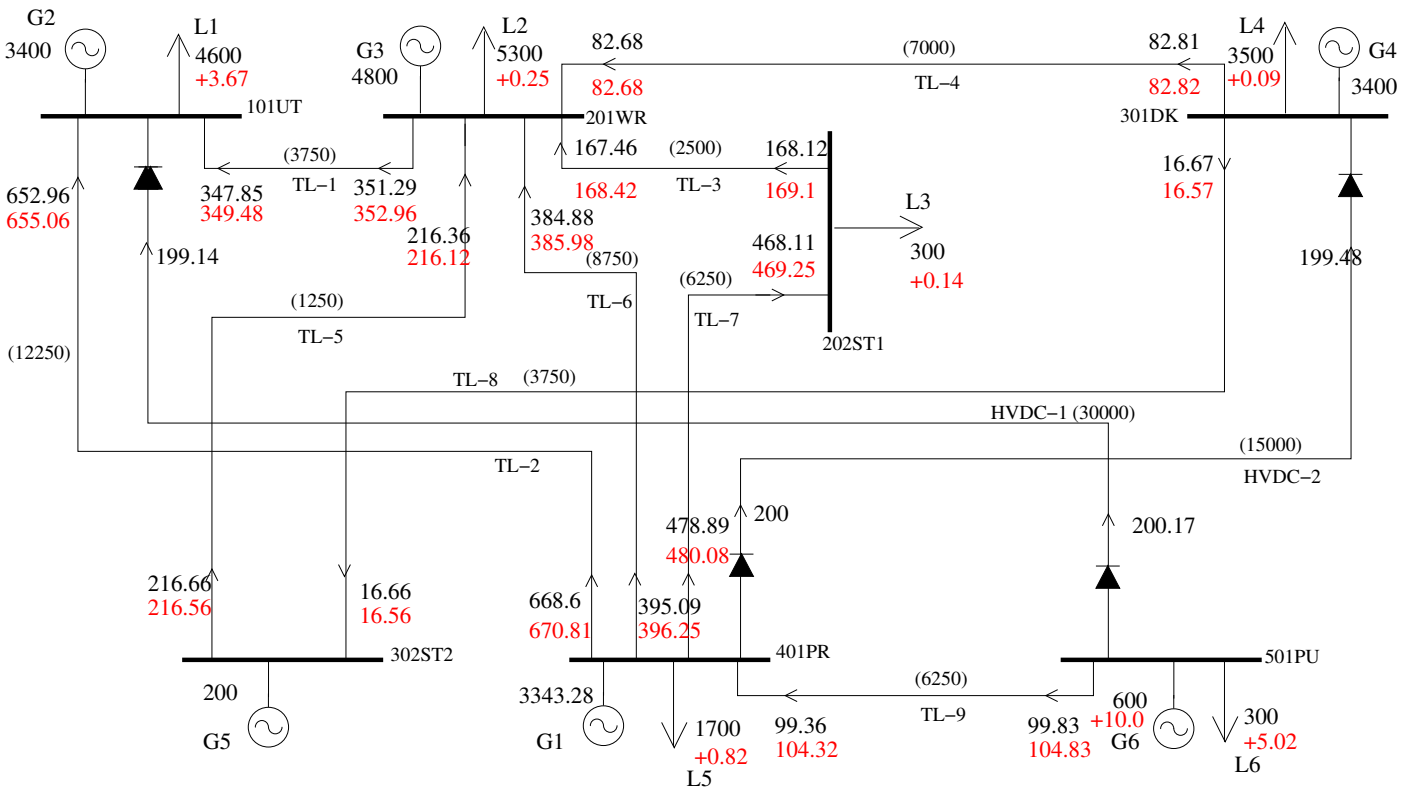


Figure: Perturbation of G6

Marginal Flow Vector:

Entity	Psch	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
G6	600	0.165	0.216	0.095	-0.005	-0.004	0.112	0.115	-0.004	0.500

Perturbation with L1

	G1	G2	G3	G4	G5	G6
L1	0.148	0.736	0.065	0.001	0.003	0.048

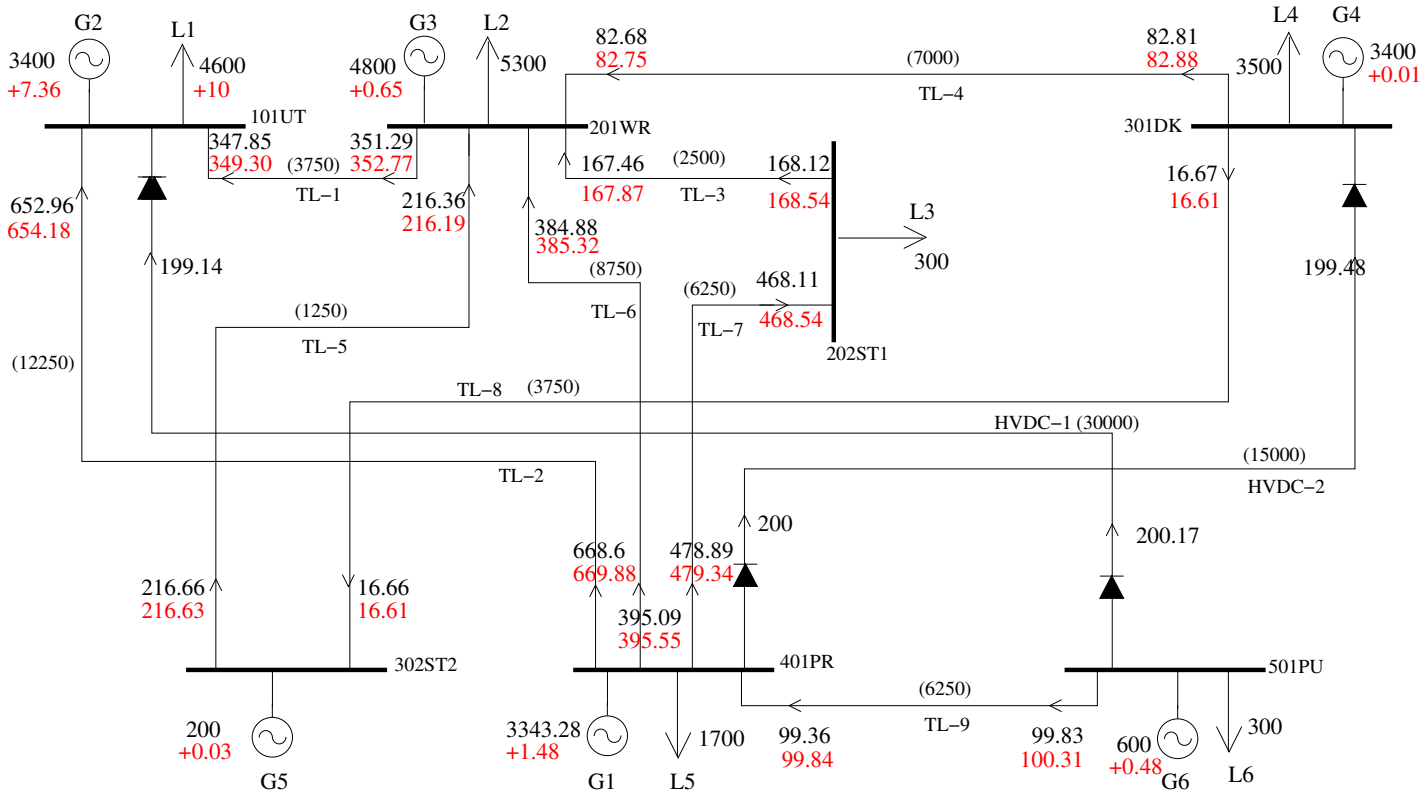


Figure: Perturbation of L1

Marginal Flow Vector:

Entity	Psch	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
L1	4600	0.147	0.123	0.039	0.001	0.003	0.042	0.041	0.000	0.048

Perturbation with L2

	G1	G2	G3	G4	G5	G6
L2	0.098	0.000	0.847	0.017	0.035	0.003

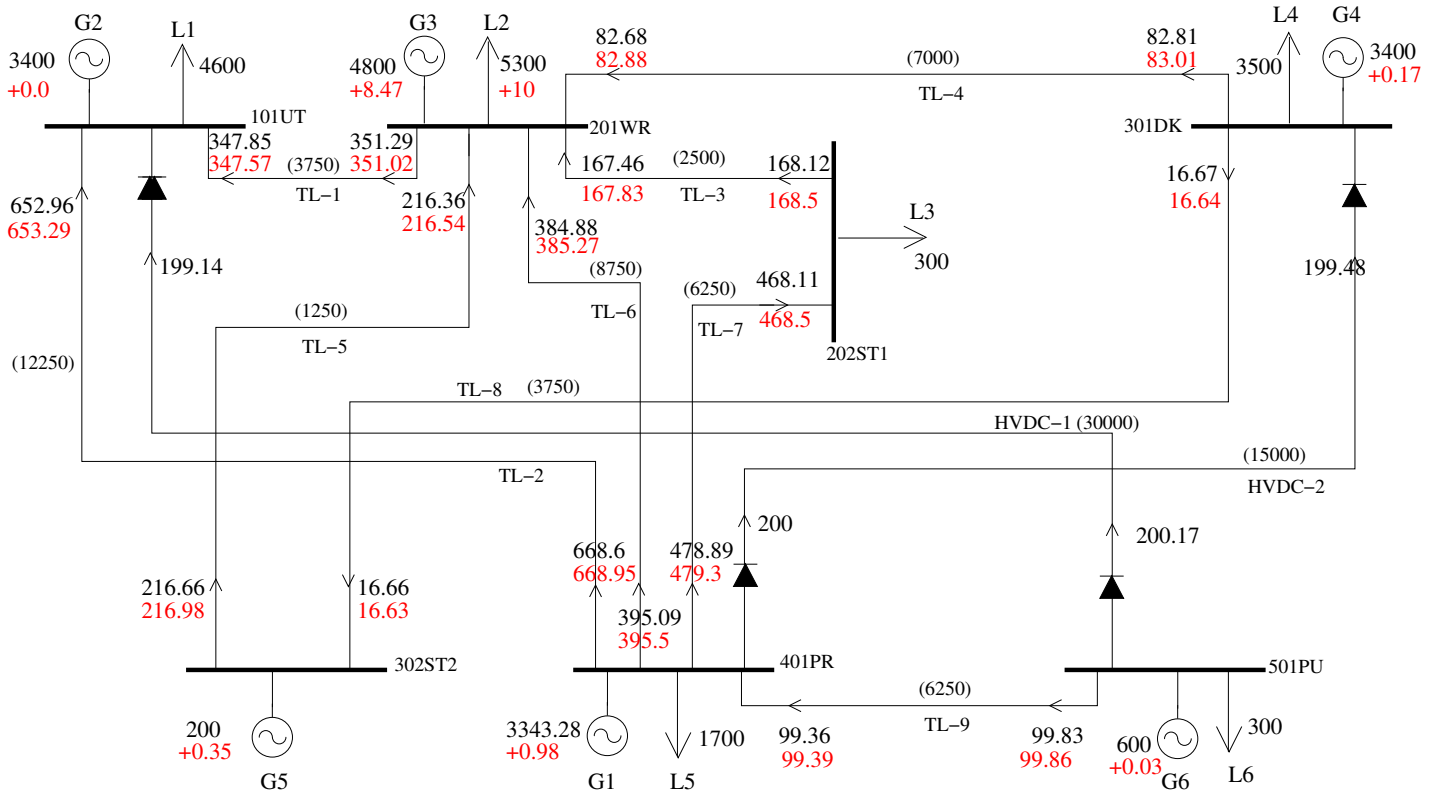


Figure: Perturbation of L2

Marginal Flow Vector:

Entity	Psch	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
L2	5300	-0.029	0.030	0.035	0.014	0.038	0.037	0.037	0.003	0.003

Perturbation with L3

	G1	G2	G3	G4	G5	G6
L3	0.971	0.000	0.000	0.000	0.000	0.029

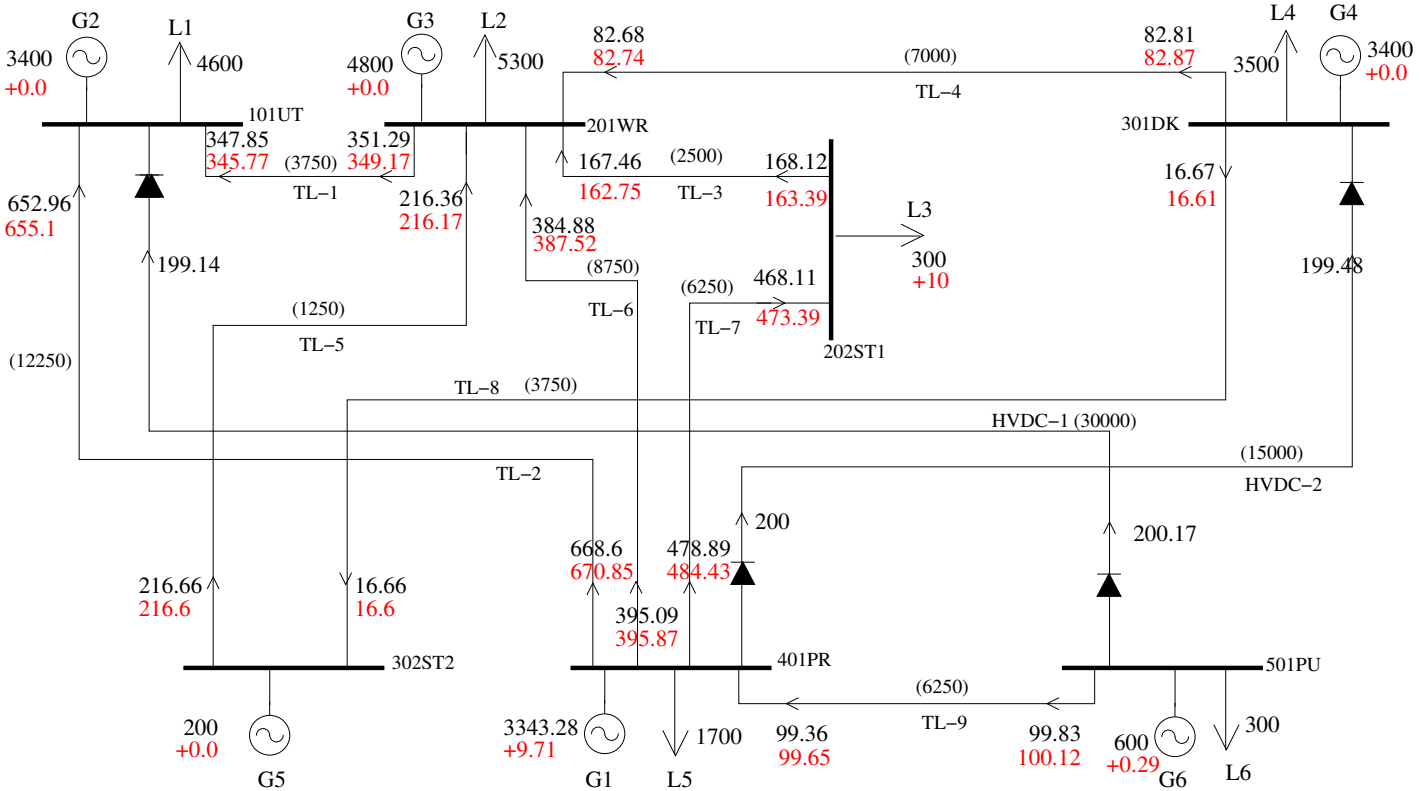


Figure: Perturbation of L3

Marginal Flow Vector:

Entity	Psch	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
L3	300	-0.213	0.220	-0.476	0.000	0.000	0.274	0.550	0.000	0.029

Perturbation with L4

	G1	G2	G3	G4	G5	G6
L4	0.054	0.000	0.000	0.944	0.000	0.002

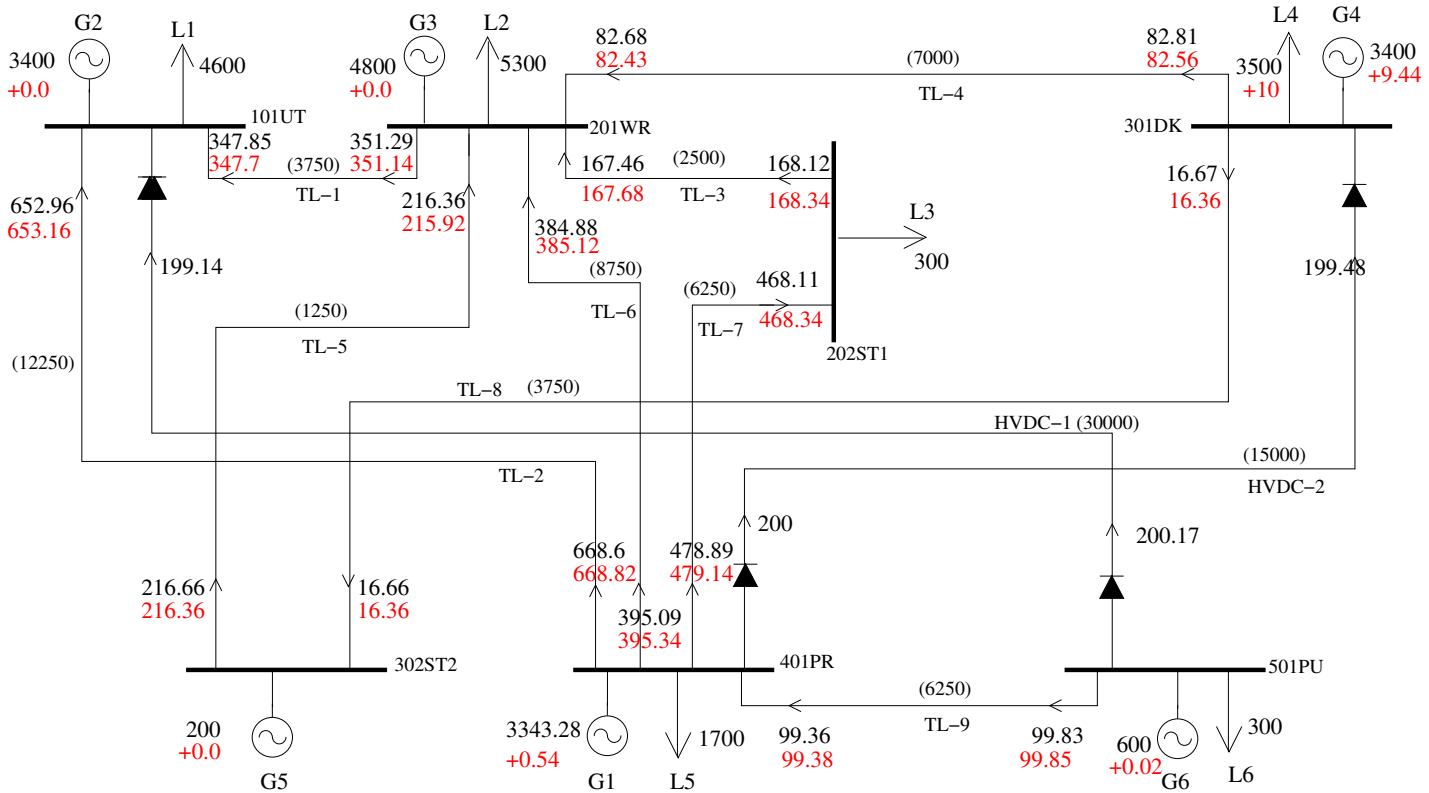


Figure: Perturbation of L4

Marginal Flow Vector:

Entity	Psch	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
L4	3500	-0.016	0.017	0.020	-0.031	-0.025	0.021	0.021	-0.025	0.002

Perturbation with L5

	G1	G2	G3	G4	G5	G6
L5	0.971	0.000	0.000	0.000	0.000	0.029

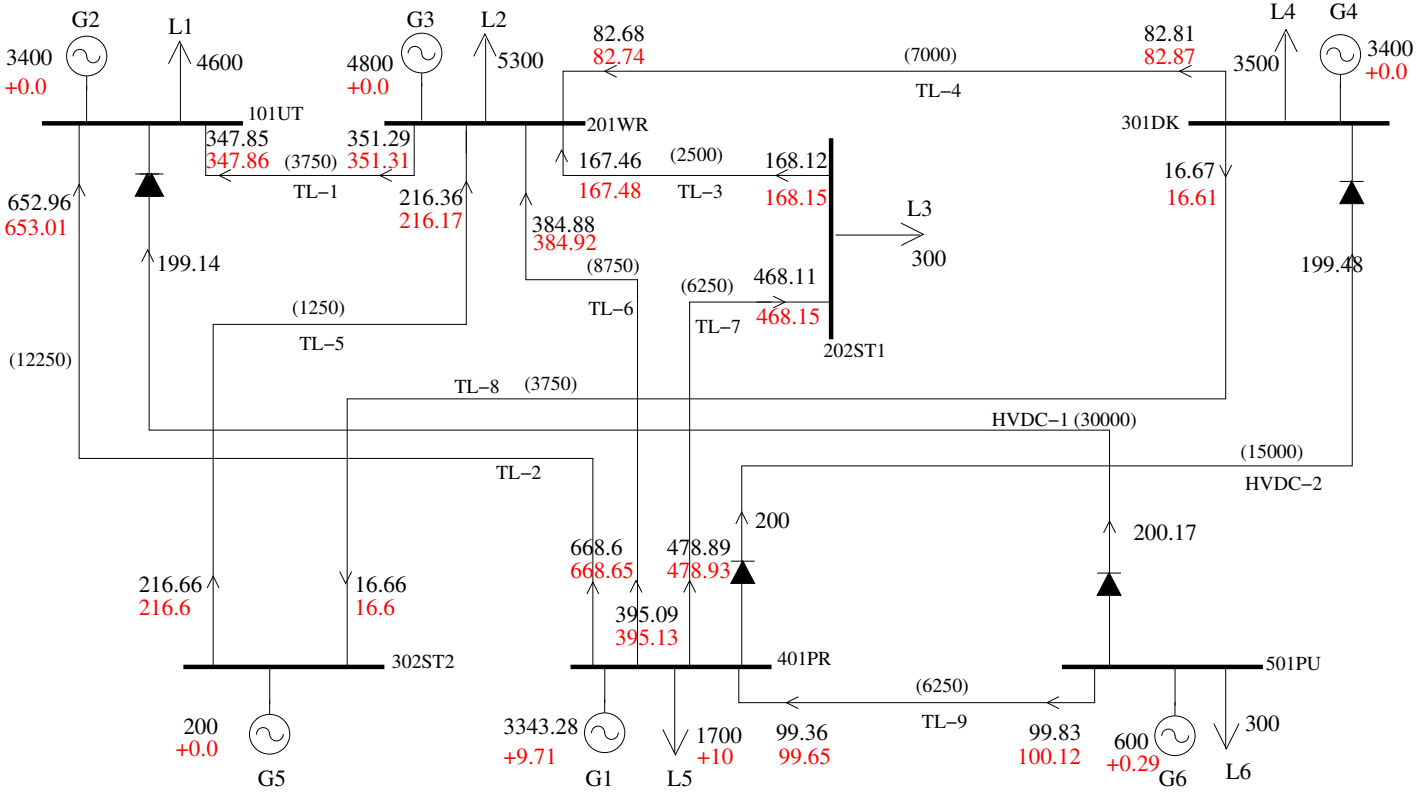


Figure: Perturbation of L5

Marginal Flow Vector:

Entity	Psch	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
L5	1700	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.029

Perturbation with L6

	G1	G2	G3	G4	G5	G6
L6	0.000	0.000	0.000	0.000	0.000	1.000

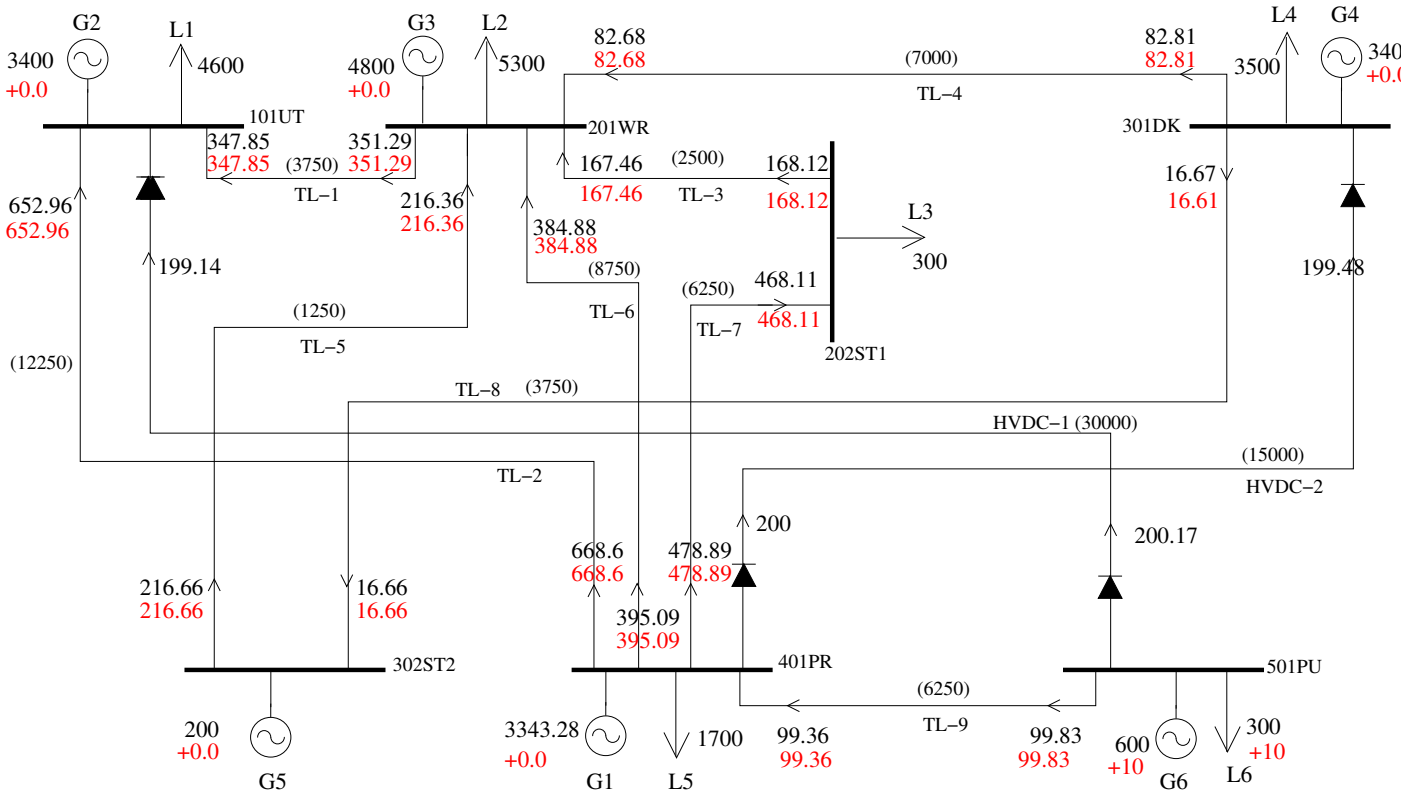


Figure: Perturbation of L6

Marginal Flow Vector:

Entity	Psch	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
L6	300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Marginal Flows

Entity	Psch	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
G1	3343.37	0.018	0.196	0.083	-0.031	-0.025	0.157	0.180	-0.025	0.000
G2	3400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
G3	4800	0.048	0.016	-0.007	0.000	0.000	-0.007	-0.007	0.000	0.000
G4	3400	0.001	0.000	0.000	0.015	0.012	0.000	0.000	0.012	0.000
G5	200	0.047	0.017	-0.006	0.138	0.862	-0.006	-0.006	-0.138	0.000
G6	600	0.165	0.216	0.095	-0.005	-0.004	0.112	0.115	-0.004	0.500
L1	4600	0.147	0.123	0.039	0.001	0.003	0.042	0.041	0.000	0.048
L2	5300	-0.029	0.030	0.035	0.014	0.038	0.037	0.037	0.003	0.003
L3	300	-0.213	0.220	-0.476	0.000	0.000	0.274	0.550	0.000	0.029
L4	3500	-0.016	0.017	0.020	-0.031	-0.025	0.021	0.021	-0.025	0.002
L5	1700	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.029
L6	300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Weighted Marginal Flows

Entity	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
G1	60.85	655.97	276.5	-104.65	-84.25	523.91	602.14	-84.22	0
G2	0	0	0	0	0	0	0	0	0
G3	231.84	74.88	-33.12	0	0	-35.04	-35.04	0	0
G4	4.42	1.7	-0.68	52.05	41.82	-0.68	-0.68	41.89	0
G5	9.44	3.34	-1.12	27.64	172.38	-1.18	-1.16	-27.65	0
G6	98.94	129.72	56.94	-3.13	-2.52	67.14	69	-2.52	300
L1	674.36	566.72	180.78	4.88	12.88	191.36	189.52	0.87	218.96
L2	-153.17	159	186.03	74.62	200.34	197.16	195.57	13.36	15.37
L3	-64.02	66	-142.65	0	0	82.17	164.97	0	8.67
L4	-56.35	58.8	68.6	-107.48	-86.45	72.8	72.1	-86.52	5.6
L5	0	0.34	0	0	0	0.17	0.17	0	49.13
L6	0	0.00	0	0	0	0.00	0.00	0	0

Neglect Negative Marginal Flow

Entity	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
G1	60.85	655.97	276.5	0	0	523.91	602.14	0	0
G2	0	0	0	0	0	0	0	0	0
G3	231.84	74.88	0	0	0	0	0	0	0
G4	4.42	1.7	0	52.05	41.82	0	0	41.89	0
G5	9.44	3.34	0	27.64	172.38	0	0	0	0
G6	98.94	129.72	56.94	0	0	67.14	69	0	300
L1	674.36	566.72	180.78	4.88	12.88	191.36	189.52	0.87	218.96
L2	0	159	186.03	74.62	200.34	197.16	195.57	13.36	15.37
L3	0	66	0	0	0	82.17	164.97	0	8.67
L4	0	58.8	68.6	0	0	72.8	72.1	0	5.6
L5	0	0.34	0	0	0	0.17	0.17	0	49.13
L6	0	0.00	0	0	0	0.00	0.00	0	0

Normalization over the line

Entity	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
G1	0.06	0.38	0.36	0.00	0.00	0.46	0.47	0.00	0.00
G2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3	0.21	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G4	0.00	0.00	0.00	0.33	0.10	0.00	0.00	0.75	0.00
G5	0.01	0.00	0.00	0.17	0.40	0.00	0.00	0.00	0.00
G6	0.09	0.08	0.07	0.00	0.00	0.06	0.05	0.00	0.50
L1	0.62	0.33	0.24	0.03	0.03	0.17	0.15	0.02	0.37
L2	0.00	0.09	0.24	0.47	0.47	0.17	0.15	0.24	0.03
L3	0.00	0.04	0.00	0.00	0.00	0.07	0.13	0.00	0.01
L4	0.00	0.03	0.09	0.00	0.00	0.06	0.06	0.00	0.01
L5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
L6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LineCost	3750	12250	2500	7000	1250	8750	6250	3750	6250

Cost allocation of Transmission Lines

Entity	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
G1	211.31	4681.32	899.06	0.00	0.00	4039.86	2909.45	0.00	0.00
G2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3	805.11	534.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G4	15.35	12.13	0.00	2288.84	122.30	0.00	0.00	2799.10	0.00
G5	32.78	23.84	0.00	1215.52	504.13	0.00	0.00	0.00	0.00
G6	343.59	925.75	185.15	0.00	0.00	517.72	333.40	0.00	3136.87
L1	2341.85	4044.39	587.83	214.40	37.67	1475.59	915.73	58.40	2289.50
L2	0.00	1134.70	604.90	3281.25	585.90	1520.31	944.96	892.49	160.71
L3	0.00	471.01	0.00	0.00	0.00	633.62	797.11	0.00	90.66
L4	0.00	419.63	223.06	0.00	0.00	561.36	348.38	0.00	58.55
L5	0.00	2.43	0.00	0.00	0.00	1.31	0.82	0.00	513.71
L6	0.00	0.0	0.00	0.00	0.00	0.0	0.0	0.00	0.00

Cost allocation of Transmission Lines

Entity	Psch	Cost
G1	3343.47	12741.01
G2	3400	0.00
G3	4800	1339.49
G4	3400	5237.72
G5	200	1776.27
G6	600	5442.47
L1	4600	11965.36
L2	5300	9125.23
L3	300	1992.39
L4	3500	1610.98
L5	1700	518.27
L6	300	0.00

Five + Two system

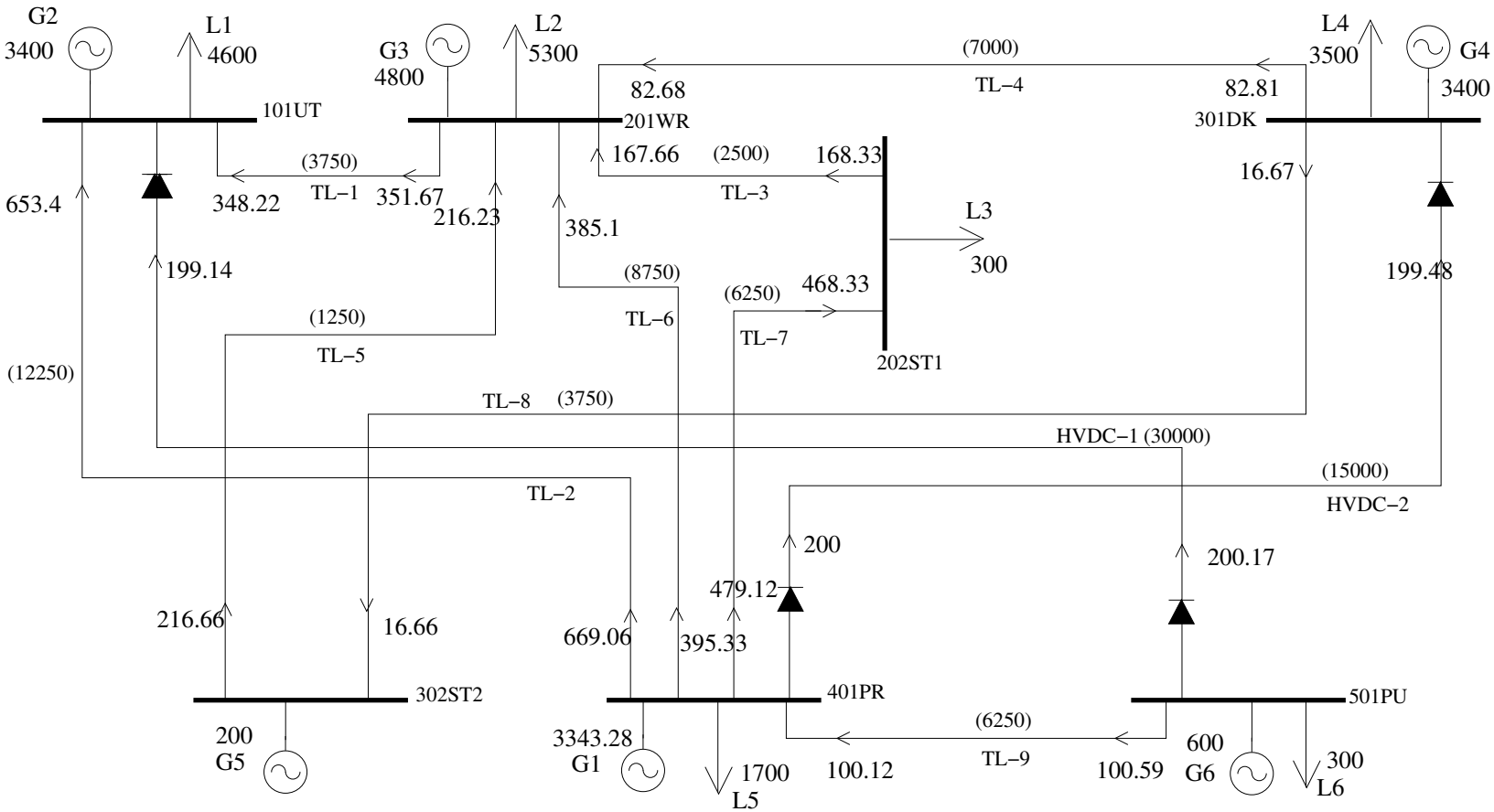


Figure: Five + Two Basic system

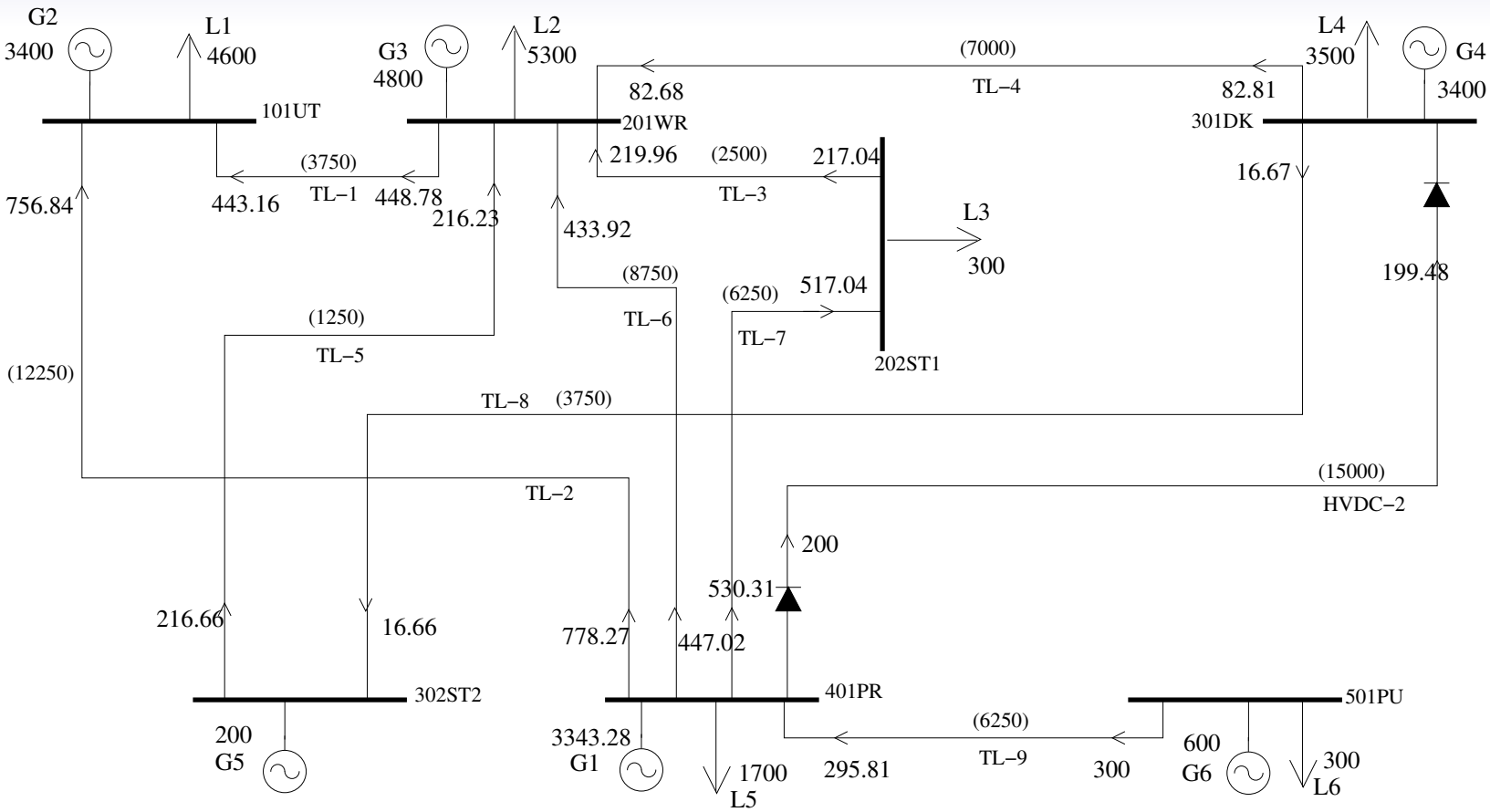


Figure: System without HVDC line 1

repeat the cost allocation for the above network and let the allocated cost vector be *Cost*1

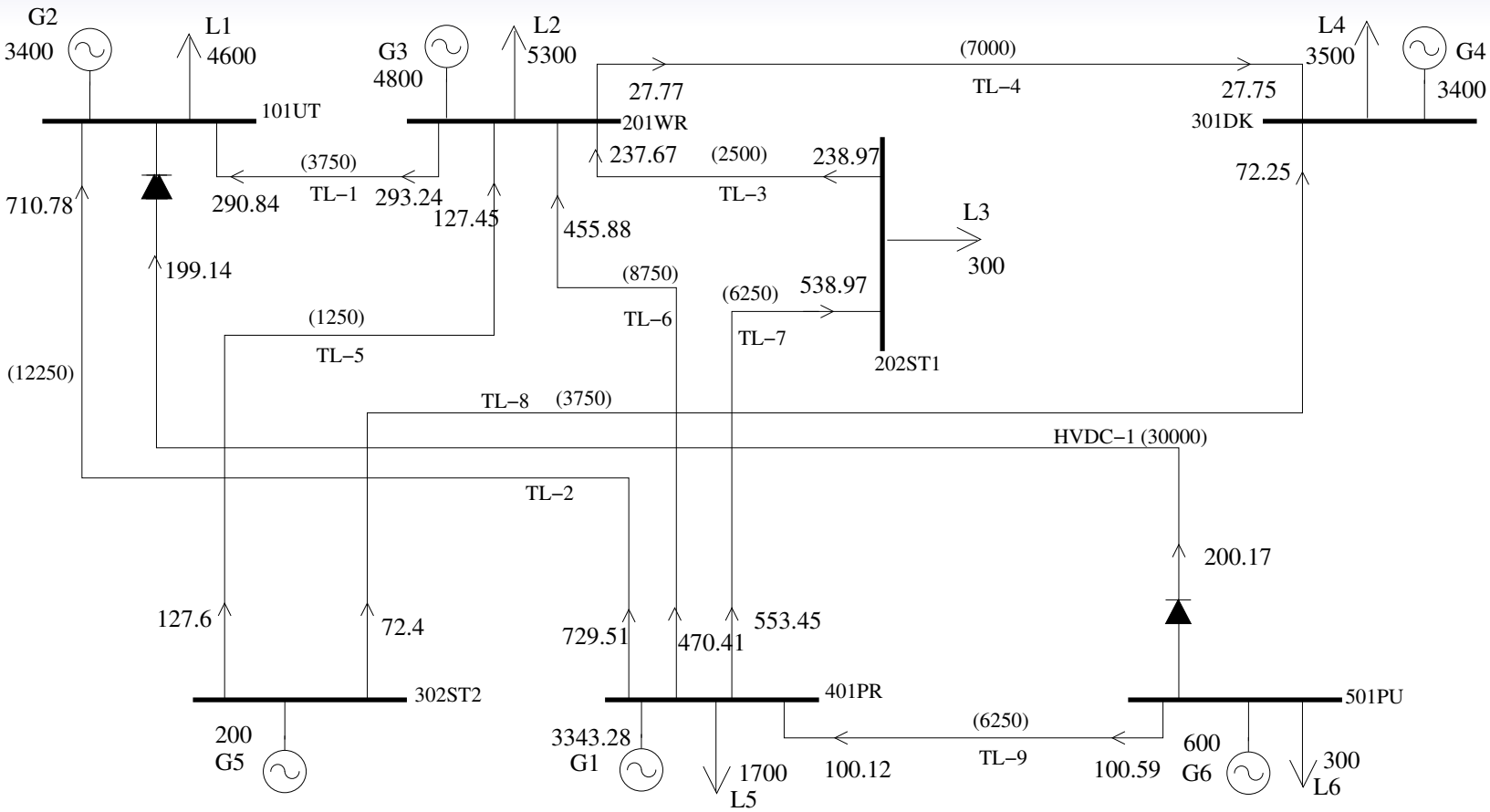


Figure: System without HVDC line 2

repeat the cost allocation for the above network and let the allocated cost vector be *Cost2*

Cost allocation of HVDCLine-1

Assume the allocated cost vector of base network is *Cost*

Entity	Cost	Cost2	Ch_Cost1	N_N_Chng	Normalize	HVDC_Alloc
G1	12741.01	13614.6	873.59	873.59	0.27	8219.86
G2	0.00	0	0	0	0	0
G3	1339.49	1645.16	305.67	305.67	0.1	2876.11
G4	5237.72	5245.64	7.92	7.92	0	74.5
G5	1776.27	1788.66	12.39	12.39	0	116.62
G6	5442.47	4384.17	-1058.3	0	0	0
L1	11965.36	9836.16	-2129.2	0	0	0
L2	9125.23	9963.42	838.19	838.19	0.26	7886.8
L3	1992.39	2130.16	137.77	137.77	0.04	1296.31
L4	1610.98	1689.17	78.19	78.19	0.02	735.69
L5	518.27	1452.89	934.62	934.62	0.29	8794.1
6	0.0	0	-0.0	0	0	0
					Sum	30000

Cost allocation of HVDCLine-2

Entity	Cost	Cost1	Ch_Cost1	N_N_Chng	Normalize	HVDC_Alloc
G1	12741.01	13230.1	489.09	489.09	0.06	917.42
G2	0.00	0	0	0	0	0
G3	1339.49	2656.2	1316.71	1316.71	0.16	2469.84
G4	5237.72	0	-5237.72	0	0	0
G5	1776.27	3474.5	1698.23	1698.23	0.21	3185.5
G6	5442.47	5462.36	19.89	19.89	0	37.31
L1	11965.36	12179.3	213.94	213.94	0.03	401.3
L2	9125.23	6372.33	-2752.9	0	0	0
L3	1992.39	1999.6	7.21	7.21	0	13.52
L4	1610.98	5862.61	4251.63	4251.63	0.53	7975.09
L5	518.27	513.05	-5.22	0	0	0
L6	0.00	0	-0.0	0	0	0
					Sum	15000

Cost allocation of HVDCLines

Entity	Psch	Cost	HVDC_Alloc1	HVDC_Alloc2	Final_Alloc	POC
G1	3343.37	12741.01	917.42	8219.86	21778.29	6.514
G2	3400	0.00	0	0	0	0.0000
G3	4800	1339.49	2469.84	2876.11	6684.045	1.3925
G4	3400	5237.72	0	74.5	5409.22	1.5624
G5	200	1776.27	3185.5	116.62	5093.39	25.3920
G6	600	5442.47	37.31	0	5478.78	9.1330
L1	4600	11965.36	401.3	0	12359.66	2.6884
L2	5300	9125.23	0	7886.8	17015.02	3.2098
L3	300	1992.39	13.52	1296.31	3290.23	10.977
L4	3500	1610.98	7975.09	735.69	10330.77	2.9491
L5	1700	518.27	0	8794.1	9312.97	5.4779
L6	300	0.00	0	0	0.0	0.0

Hybrid Method for Sharing of Inter-state Transmission Losses - CERC Regulations,2010

- The change in the losses because of incremental injection/drawal at each node are computed
- The change in overall system losses per unit of injection/drawal at each node is termed as Marginal Loss Factor

$$K_i = \frac{\partial \text{System losses}}{\partial \text{Power injection/drawal at node i}}$$

Hybrid Method for Sharing of Inter-state Transmission Losses - CERC Regulations,2010 (cont.)

- Loss Allocation factors for generation and demand nodes are computed by:

$$LAF(P_i^g) = \frac{K_i \times P_i^g}{\sum_i K_i \times P_i^g + \sum_j K_j \times P_j^d}$$

$$LAF(P_j^d) = \frac{K_j \times P_j^d}{\sum_j K_j \times P_j^d + \sum_i K_i \times P_i^g}$$

where

P_i^g = base case generation at node i

P_j^d = base case drawal at node j

- $\sum LAF(P_i^g) + \sum LAF(P_j^d) = 1$

Hybrid Method for Sharing of Inter-state Transmission Losses - CERC Regulations,2010 (cont.)

- Losses Allocated $= LAF(P_i^g) \times$ Total System losses

  Losses Allocated $= LAF(P_j^d) \times$ Total System losses

  Note: HVDC losses are included
- No special treatment is required for HVDC lines
- Special linewise Loss Allocation is not required
- Different generators (or loads) at a node will have identical Marginal LF
- LAF of generator (load) at a node will change in proportion to their injection / drawal
- Used for scheduling purpose

Marginal Loss and Loss Factor

Entity	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6	TL-7	TL-8	TL-9
G1	0.0003	0.0095	0.0007	-0.0001	0.0000	0.0080	0.0082	0.0000	0.0000
G2	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
G3	0.0009	0.0008	-0.0001	0.0000	0.0000	-0.0004	-0.0003	0.0000	0.0000
G4	0.0000	0.0001	0.0000	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000
G5	0.0009	0.0009	0.0000	0.0004	0.0035	-0.0004	-0.0002	-0.0001	0.0000
G6	0.0032	0.0104	0.0007	0.0000	0.0000	0.0058	0.0053	0.0000	0.0048
L1	0.0028	0.0061	0.0002	0.0000	0.0000	0.0021	0.0020	0.0000	0.0005
L2	-0.0006	0.0016	0.0003	0.0001	0.0001	0.0020	0.0018	0.0000	0.0001
L3	-0.0042	0.0107	-0.0026	0.0000	0.0000	0.0143	0.0254	0.0000	0.0003
L4	-0.0004	0.0009	0.0002	-0.0001	-0.0001	0.0011	0.0010	0.0000	0.0000
L5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003
L6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

$$lossfactor = \frac{\partial systemloss}{\partial schedule} \tag{1}$$

Weighted Marginal loss

Entity	Psch	LossFactor	WLF	N-WLF	LossAlloc
G1	3343.28	0.0266	88.831	0.390	17.23
G2	3400	0.0001	0.340	0.0001	0.036
G3	4800	0.0009	4.320	0.019	0.8641
G4	3400	0.0003	0.884	0.0024	0.0972
G5	200	0.0050	1.006	0.0045	0.1926
G6	600	0.0302	18.108	0.080	3.505
L1	4600	0.0137	63.066	0.277	12.08
L2	5300	0.0053	28.355	0.1125	5.10
L3	300	0.0439	13.170	0.0584	2.5364
L4	3500	0.0026	9.030	0.0390	1.6598
L5	1700	0.0003	0.510	0.002	0.0956
L6	300	0.0000	0.000	0.000	0.0010

WLF is Weighted Loss Factor
N-WLF is normalized Weighted Loss Factor
Total loss of the system is: 43.372 MW

Discussion!.....

Thank you..