EEE 306 PROJECT PRESENTATION
INVESTIGATING THE EFFECT OF HVDC CONNECTION AND LARGE INDUSTRIAL LOADS IN IEEE 39-BUS NETWORK

Submitted to:

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ABOUT THE PROJECT:

Investigating

- Investigating the effect of HVDC connection and large industrial loads in IEEE-39 bus network

Performing

- Performing load flow analysis of the system (in base case)

Finding

- Finding circuit breaker rating of generators (in base case)

Performing

- Performing load flow analysis for the network modified with PV generator

Performing

- Performing load flow analysis of the system with an additional induction motors

Fixing

- Fixing abnormalities of the system by using correcting devices and measures

TASK 1

Load Flow analysis of the Power system (Base Case)

All data given in the datasheet has been entered in the system.

Any values not mentioned in the datasheet has been given default values provided by PSAF or assumed accordingly.

Newton-Raphson Solver with "Flat Start" condition and "No Constraints" have been used.

LOAD FLOW STUDY PARAMETERS

Study :	ModelGrid7
Time :	Sun Jul 18 22h04m02s 2021
Method :	Newton-Raphson
Constraints :	Not applied
Flat start :	Yes
Tcul txfo used as fixed tap :	n\a
Block Q-flow Txfo Adjustment	n\a
Block P-flow Txfo Adjustment :	n\a
Block Switchable Shunt Adjustment :	n\a
Block DC Link Adjustment :	n\a
Base power :	100.00 [MVA]
Tolerance :	0.100 [MVA]

COMPLETE SUMMARY REPORT

Summary Data	**Active Power**	**Reactive Power**
Total generation	**6151.363**	**1378.503**
Spinning reserve	7528.637	
Static Load	6097.100	1408.900
Shunt loads	0.000	0.000
Motor loads	0.000	0.000
Total load	**6097.100**	**1408.900**
Line / cable losses	33.699	-637.283
Transformer losses	20.565	606.886
Total losses	**54.264**	**-30.397**
Mismatches	-0.000	-0.001

	ID						
1							
2	***BUSES OUTSIDE VOLTAGE LIMITS (100 %)***						
3							
4	Bus ID	Zone	kV Base	Vmin - [pu]	Vmax - [pu]	V sol - [pu]	Ang sol - [deg]
5							
6	***OVERLOADED LINES & CABLES (WITHIN 100 %)***						
7	ID	Bus From	Bus To	Power Flow - [A]	Loading Limit - [A]	Emergency Loading Limit - [A]	
8							
9	***UNDERLOADED LINES & CABLES (WITHIN 50 %)***						
10	ID	Bus From	Bus To	Power Flow - [A]	Loading Limit - [A]		
11	L30	B25	B26	322.3	400.0		
12	L21	B16	B17	471.2	600.0		
13	L12	B6	B11	594.8	600.0		
14	L22	B16	B19	854.6	900.0		
15	L32	B26	B28	227.9	400.0		
16	L33	B26	B29	308.3	400.0		
17	L14	B7	B9	310.9	400.0		
18	L24	B16	B24	247.3	400.0		
19	L15	B9	B39	249.2	400.0		
20	L26	B17	B27	119.7	400.0		
21	L28	B22	B23	71.0	400.0		
22	L19	B10	B15	125.9	400.0		
23	L1	B1	B2	207.6	400.0		
24	L2	B1	B39	207.6	400.0		
25	L5	B3	B4	344.2	400.0		

TASK 1

The Newton-Raphson Calculation of the System Converged.

No notable errors or abnormalities can be seen.

But there are some underloaded lines.

So, we can conclude all data has been entered correctly.

	ID						
1							
2	***BUSES OUTSIDE VOLTAGE LIMITS (100 %)***						
3							
4	Bus ID	Zone	kV Base	Vmin - [pu]	Vmax - [pu]	V sol - [pu]	Ang sol - [deg]
5							
6	***OVERLOADED LINES & CABLES (WITHIN 100 %)***						
7	ID	Bus From	Bus To	Power Flow - [A]	Loading Limit - [A]	Emergency Loading Limit - [A]	
8							
9	***UNDERLOADED LINES & CABLES (WITHIN 50 %)***						
10	ID	Bus From	Bus To	Power Flow - [A]	Loading Limit - [A]		
11	L30	B25	B26	322.3	400.0		
12	L21	B16	B17	471.2	600.0		
13	L12	B6	B11	594.8	600.0		
14	L22	B16	B19	854.6	900.0		
15	L32	B26	B28	227.9	400.0		
16	L33	B26	B29	308.3	400.0		
17	L14	B7	B9	310.9	400.0		
18	L24	B16	B24	247.3	400.0		
19	L15	B9	B39	249.2	400.0		
20	L26	B17	B27	119.7	400.0		
21	L28	B22	B23	71.0	400.0		
22	L19	B10	B15	125.9	400.0		
23	L1	B1	B2	207.6	400.0		
24	L2	B1	B39	207.6	400.0		
25	L5	B3	B4	344.2	400.0		
26	L6	B3	B18	186.3	400.0		
27	L7	B4	B5	212.1	400.0		
28							
29	***OVERLOADED TRANSFORMERS (WITHIN 100 %)***						
30	ID	Bus From	Bus To	Power Flow - [MVA]	Loading Limit - [MVA]	Emergency Loading Limit - [MVA]	
31							
32	***UNDERLOADED TRANSFORMERS (WITHIN 50 %)***						
33	ID	Bus From	Bus To	Power Flow - [MVA]	Loading Limit - [MVA]		
34	T10	B2	B30	302.6	550.0		
35	T01	B12	B11	43.3	250.0		
36	T02	B12	B13	45.4	250.0		
37	T12	B19	B20	123.3	550.0		
38	T06	B20	B34	513.8	700.0		
39							
40	***GENERATORS AT REACTIVE LIMITS (WITHIN 0 %)***						
41	ID	Bus From	P Gen - [MW]	Q Gen - [MVAR]	Q Min - [MVAR]	Q Max - [MVAR]	
42							
43	***TRANSFORMERS AT TAP LIMITS (WITHIN 0 %)***						
44	ID	Bus From	Bus To	Tap Pos - [%]	Min Tap - [%]	Max Tap - [%]	

TASK 2

1) Definition of Circuit Breaker

2) Parameters of Circuit Breaker Rating-

- **A) Rated Operating Voltage**
- **B) Rated Symmetrical Short Circuit Current**
- **C) Max Symmetrical Interrupting Current**
- **D) Continuous Current**
- **E) Rated Continuous Current**
- **F) Interrupting Rating (MVA)**

BEFORE FAULT

	ID	Bus ID	DBase ID	Type	Rated S [MVA]	kV Nominal	Generator Type	P [MW]	Q [MVAR]	S [MVA]	P. Factor [%]	I [A]
1	G10	B30	G10	Generator	1000.00	17.28	PV	250.00	96.49	267.97	93.3	9376.7
2	G01	B39	G01	Generator	10000.00	355.35	PV	1000.00	196.55	1019.13	98.1	1705.5
3	G02	B31	G02	Generator	700.00	16.20	SW	532.69	227.98	579.42	91.9	20274.6
4	G03	B32	G03	Generator	800.00	16.22	PV	650.00	237.60	692.06	93.9	24216.0
5	G04	B33	G04	Generator	800.00	16.45	PV	632.00	137.18	646.72	97.7	22629.2
6	G05	B34	G05	Generator	300.00	16.70	PV	508.00	130.91	524.60	96.8	18356.1
7	G06	B35	G06	Generator	800.00	17.31	PV	650.00	179.74	674.39	96.4	23597.6
8	G07	B36	G07	Generator	700.00	17.55	PV	560.00	133.66	575.73	97.3	20145.3
9	G08	B37	G08	Generator	700.00	16.96	PV	540.00	63.77	543.75	99.3	19026.4
10	G09	B38	G09	Generator	1000.00	16.94	PV	830.00	28.98	830.51	99.9	29060.2

AFTER FAULT

	ID	Type	Prefault kV	Angle	Fault type	Fault S [MVA]	IL1 [A]	IL1 [deg]	IL2 [A]	IL2 [deg]	IL3 [A]	IL3 [deg]	In [A]	In [deg]
1	Faulted Bus ->													
2														
3	B30		16.50	0.00	LLL	9765	341703.7136	-86.3436	341703.7125	153.6564	341703.7125	33.6564	0.0000	0.0000
4	B30		16.50	0.00	LG	0.4	13.5835	-0.0097	0.0000	0.0000	0.0000	0.0000	13.5835	-0.0097
5														
6	First Ring Contributions													
7														
8	G10	Generator	16.50	0.00	LLL	6314	220936.5499	-87.1376	220936.5492	152.8624	220936.5492	32.8624	0.0000	0.0000
9		Generator	16.50	0.00	LG	0.3	10.3924	-0.1929	1.5444	0.6491	1.6050	0.6246	13.5415	0.0000
10	T10	Fixed-Tap Xmer	16.50	0.00	LLL	3453	120827.1953	-84.8917	120827.1949	155.1083	120827.1949	35.1083	0.0000	0.0000
11		Fixed-Tap Xmer	16.50	0.00	LG	0.1	3.2199	1.2454	1.6100	-178.7546	1.6100	-178.7546	0.0000	0.0000
12														
13	Faulted Bus ->													
14														
15	B31		16.50	0.00	LLL	7150	250195.9950	-85.5719	250195.9941	154.4281	250195.9941	34.4281	0.0000	0.0000
16	B31		16.50	0.00	LG	0.4	13.0481	-0.0103	0.0000	0.0000	0.0000	0.0000	13.0481	-0.0103
17														
18	First Ring Contributions													
19														
20	G02	Generator	16.50	0.00	LLL	4425	154845.3746	-84.2894	154845.3741	155.7106	154845.3741	35.7106	0.0000	0.0000
21		Generator	16.50	0.00	LG	0.3	9.7277	0.4122	1.7055	-1.1756	1.5844	-1.2655	13.0166	-0.0000
22	T03	Fixed-Tap Xmer	16.50	0.00	LLL	2728	95452.3734	-87.6527	95452.3731	152.3473	95452.3731	32.3473	0.0000	0.0000
23		Fixed-Tap Xmer	16.50	0.00	LG	0.1	3.2908	-1.8280	1.6151	178.1377	1.6757	178.2051	0.0000	0.0000

	ID	Type	Prefault kV	Angle	Fault type	Fault S [MVA]	IL1 [A]	IL1 [deg]	IL2 [A]	IL2 [deg]	IL3 [A]	IL3 [deg]	In [A]	In [deg]
88	B37		16.50	0.00	LG	0.4	13.8354	-0.0103	0.0000	0.0000	0.0000	0.0000	13.8354	-0.0103
89														
90	First Ring Contributions													
91														
92	G08	Generator	16.50	0.00	LLL	4679	163718.4720	-87.1376	163718.4715	152.8624	163718.4715	32.8624	0.0000	0.0000
93		Generator	16.50	0.00	LG	0.3	10.2876	-0.3898	1.7243	1.1628	1.8455	1.0864	13.8564	0.0000
94	T09	Fixed-Tap Xmer	16.50	0.00	LLL	2936	102717.8577	-84.2411	102717.8574	155.7589	102717.8574	35.7589	0.0000	0.0000
95		Fixed-Tap Xmer	16.50	0.00	LG	0.1	3.5718	2.2457	1.7859	-177.7543	1.7859	-177.7543	0.0000	0.0000
96														
97	Faulted Bus ->													
98														
99	B38		16.50	0.00	LLL	7906	276620.8253	-86.7088	276620.8244	153.2912	276620.8244	33.2912	0.0000	0.0000
100	B38		16.50	0.00	LG	0.4	13.8564	-0.0101	0.0000	0.0000	0.0000	0.0000	13.8564	-0.0101
101														
102	First Ring Contributions													
103														
104	G09	Generator	16.50	0.00	LLL	6710	234796.0816	-87.1376	234796.0808	152.8624	234796.0808	32.8624	0.0000	0.0000
105		Generator	16.50	0.00	LG	0.4	12.4568	-0.1609	0.6697	1.4969	0.7303	1.3727	13.8564	-0.0000
106	T11	Fixed-Tap Xmer	16.50	0.00	LLL	1197	41868.1960	-84.3033	41868.1959	155.6967	41868.1959	35.6967	0.0000	0.0000
107		Fixed-Tap Xmer	16.50	0.00	LG	0.0	1.4014	2.8624	0.7007	-177.1376	0.7007	-177.1376	0.0000	0.0000
108														
109	Faulted Bus ->													
110														
111	B39		345.00	0.00	LLL	69032	115524.4350	-87.0985	115524.4346	152.9015	115524.4346	32.9015	0.0000	0.0000
112	B39		345.00	0.00	LG	173	288.8478	1.4093	0.0000	0.0000	0.0000	0.0000	288.8478	1.4093
113														
114	First Ring Contributions													
115														
116	G01	Generator	345.00	0.00	LLL	66417	111148.0018	-87.1376	111148.0015	152.8624	111148.0015	32.8624	0.0000	0.0000
117		Generator	345.00	0.00	LG	168	281.4942	0.8608	4.3716	-33.5052	4.3571	-33.6315	288.7360	-0.1186
118	L15	Line	345.00	0.00	LLL	1277	2137.7635	-86.7436	2137.7634	153.2564	2137.7634	33.2564	0.0000	0.0000
119		Line	345.00	0.00	LG	2.3	3.8100	20.6798	2.1332	146.4221	2.1332	146.4221	3.7051	89.8447
120	L2	Line	345.00	0.00	LLL	1338	2239.6063	-85.4950	2239.6063	154.5050	2239.6063	34.5050	0.0000	0.0000
121		Line	345.00	0.00	LG	2.4	4.0347	22.2780	2.2311	146.4410	2.2311	146.4410	3.9963	89.7841

Global Voltage Report | Global Current Report | Global G Report | Faulted Bus -> (V) report | Faulted Bus -> (Z / IEC) report | Faulted Bus -> (I) report

TASK 2

1) The Max Symmetrical Interrupting Current rating of circuit breaker---

Generator-5 => lowest

Generator-9 => highest

2)Interrupting rating is so much high for generator-1

3) Cause of choosing SF_6 Circuit Breaker

(Max Symmetrical Interrupting Current for SF6 Circuit breaker is between 50kA to 275kA.)

Generator No	Rated Operating Voltage	Rated Symmetrical Short Circuit Current	Max Symmetrical Interrupting Current	Continuous Current	Rated Continuous Current	Interrupting Rating (MVA)
G01	345	111148.0018	120000	1705.5	1800	71.71
G02	16.5	154845.3746	160000	20274.6	21000	4.57
G03	16.5	213824.4829	220000	24216.0	25000	6.29
G04	16.5	204868.7873	210000	22629.2	23000	6.00
G05	16.5	73440.9349	74000	18356.1	19000	2.11
G06	16.5	175862.5191	180000	23597.6	24000	5.144
G07	16.5	147779.9466	150000	20145.3	21000	4.29
G08	16.5	163718.4720	170000	19026.4	20000	4.85
G09	16.5	234796.0816	240000	29060.2	30000	6.86
G10	16.5	220936.5499	230000	9376.7	10000	6.57

TASK 3

1)We modified G03 ,G04,G05 and G07 generators to PV generators and perform Power flow analysis.

2) For PV generator the fault current is same as the rated current of the generator.

3)So to emulate this effect, we changed fault current of PV generator into corresponding rated current by increasing sub transient X". We also increase transient X' and steady state X to validate this modification (because X"<X'<X).

4)It was a trial-and-error method. And after some trial we got our desired output that satisfies our condition. It is shown by a table in the next slide.

COMPLETE SUMMARY REPORT

Summary Data	Active Power	Reactive Power
Total generation	**6151.593**	**1348.489**
Spinning reserve	7818.407	
Static Load	6097.100	1408.900
Shunt loads	0.000	0.000
Motor loads	0.000	0.000
Total load	**6097.100**	**1408.900**
Line / cable losses	33.967	-665.966
Transformer losses	20.525	605.556
Total losses	**54.493**	**-60.411**
Mismatches	0.000	-0.000

Bus | Generator | Static Load | Branch | Transformer | Abnormal Report | Summary Report

	ID	Type	Prefault kV	Angle	Fault type	Fault S [MVA]	IL1 [A]	IL1 [deg]	IL2 [A]	IL2 [deg]
1	**Faulted Bus ->**									
2										
3	B32		16.50	0.00	LLL	3736	130724.5034	-87.2643	130724.5030	152.73
4										
5	**First Ring Contributions**									
6										
7	G03	Generator	16.50	0.00	LLL	800	27993.9355	-87.1376	27993.9354	152.86
8	T04	Fixed-Tap Xmer	16.50	0.00	LLL	2936	102730.6237	-87.2989	102730.6234	152.70
9										
10	**Faulted Bus ->**									
11										
12	B33		16.50	0.00	LLL	3168	110841.5039	-86.4737	110841.5036	153.52
13										
14	**First Ring Contributions**									
15										
16	G04	Generator	16.50	0.00	LLL	799	27951.7903	-87.1376	27951.7903	152.86
17	T05	Fixed-Tap Xmer	16.50	0.00	LLL	2369	82892.2655	-86.2498	82892.2653	153.75
18										
19	**Faulted Bus ->**									
20										
21	B34		16.50	0.00	LLL	2142	74947.9242	-86.6610	74947.9239	153.3
22										
23	**First Ring Contributions**									
24										
25	G05	Generator	16.50	0.00	LLL	300	10495.1157	-87.1376	10495.1156	152.8
26	T06	Fixed-Tap Xmer	16.50	0.00	LLL	1842	64453.2471	-86.5835	64453.2468	153.4
27										
28	**Faulted Bus ->**									
29										
30	B36		16.50	0.00	LLL	2946	103069.2542	-87.7053	103069.2539	152.2
31										
32	**First Ring Contributions**									
33										
34	G07	Generator	16.50	0.00	LLL	699	24448.2217	-87.1376	24448.2216	152.8
35	T08	Fixed-Tap Xmer	16.50	0.00	LLL	2247	78622.5861	-87.8818	78622.5858	152.1

TASK 3

From the table we can see that fault current contributions are approximately equal to corresponding rated current of generators.

Bus	Generator (PV generator)	Rated Current (A)	Fault Current Contribution (A)	Modified Sub-transient Value, X'' (pu)
B32	G03	27992.7	27993.9355	1.94
B33	G04	27992.7	27951.7903	1.8
B34	G05	10497.27	10495.1157	12
B36	G07	24493.64	24448.2217	1.305

TASK 4

In case 4, we study the effects of large industrial loads in the system

10 Induction Motors have been added to Bus 23 to emulate this.

The Induction Motors increase the real and reactive power consumption of the system.

Also, they lower the total power factor of the system as they are huge inductive loads.

Making such as significant change has an impact on the power system.

LOAD FLOW STUDY PARAMETERS	
Study :	ModelGrid7
Time :	Sun Jul 18 22h25m04s 2021
Method :	Newton-Raphson
Constraints :	Not applied
Flat start :	Yes
Tcul txfo used as fixed tap :	n\a
Block Q-flow Txfo Adjustment	n\a
Block P-flow Txfo Adjustment :	n\a
Block Switchable Shunt Adjustment :	n\a
Block DC Link Adjustment :	n\a
Base power :	100.00 [MVA]
Tolerance :	0.100 [MVA]

COMPLETE SUMMARY REPORT

Summary Data	**Active Power**	**Reactive Power**
Total generation	**6965.593**	**2533.967**
Spinning reserve	6714.407	
Static Load	6097.100	1408.900
Shunt loads	0.000	0.000
Motor loads	800.000	600.000
Total load	**6897.100**	**2008.900**
Line / cable losses	34.667	-602.097
Transformer losses	33.826	1127.164
Total losses	**68.493**	**525.067**
Mismatches	0.000	-0.000

Bus | Generator | Motor | Static Load | Branch | Transformer | Abnormal Report | Summary Report

TASK 4

After modifying the network with 10 Induction Motors, the following abnormalities can be seen.

1. Overload of lines 11, 28, 19, 9

Which is due to the increased load and decreased power factor.

2. Overload of Transformer 3

Which Connected to the swing generator supplying the induction motors.

3. Reactive voltage limit at Generators 6 and 7

Reactive power generation limits of the system cannot balance the reactive power consumption of the motors

	ID						
1							
2	BUSES OUTSIDE VOLTAGE LIMITS (100 %)						
3							
4	Bus ID	Zone	kV Base	Vmin - [pu]	Vmax - [pu]	V sol - [pu]	Ang sol - [deg]
5							
6	OVERLOADED LINES & CABLES (WITHIN 100 %)						
7	ID	Bus From	Bus To	Power Flow - [A]	Loading Limit - [A]	Emergency Loading Limit - [A]	
8	L11	B6	B7	912.7	800.0	850.0	
9	L28	B22	B23	938.3	800.0	850.0	
10	L19	B10	B15	864.2	800.0	850.0	
11	L9	B5	B6	1337.7	1200.0	1800.0	
12							
13	UNDERLOADED LINES & CABLES (WITHIN 50 %)						
14	ID	Bus From	Bus To	Power Flow - [A]	Loading Limit - [A]		
15	L20	B15	B16	485.6	600.0		
16	L30	B25	B26	330.5	400.0		
17	L21	B16	B17	232.9	600.0		
18	L12	B6	B11	241.4	600.0		
19	L22	B16	B19	875.2	900.0		
20	L32	B26	B28	230.2	400.0		
21	L23	B16	B21	164.1	400.0		
22	L33	B26	B29	310.9	400.0		
23	L15	B9	B39	344.5	400.0		
24	L25	B17	B18	34.1	400.0		
25	L16	B10	B11	261.6	600.0		
26	L26	B17	B27	246.8	400.0		
27	L27	B21	B22	386.4	600.0		
28	L29	B23	B24	110.2	400.0		
29	L1	B1	B2	73.5	400.0		
30	L2	B1	B39	73.5	400.0		
31	L4	B2	B25	213.1	400.0		
32	L6	B3	B18	238.0	400.0		
33							
34	OVERLOADED TRANSFORMERS (WITHIN 100 %)						
35	ID	Bus From	Bus To	Power Flow - [MVA]	Loading Limit - [MVA]	Emergency Loading Limit - [MVA]	
36	T03	B6	B31	1325.2	800.0	850.0	
37							
	ID						
36	T03	B6	B31	1325.2	800.0	850.0	
37							
38	UNDERLOADED TRANSFORMERS (WITHIN 50 %)						
39	ID	Bus From	Bus To	Power Flow - [MVA]	Loading Limit - [MVA]		
40	T10	B2	B30	316.4	550.0		
41	T01	B12	B11	44.7	250.0		
42	T02	B12	B13	48.1	250.0		
43	T12	B19	B20	123.2	550.0		
44	T06	B20	B34	518.8	700.0		
45							
46	GENERATORS AT REACTIVE LIMITS (WITHIN 0 %)						
47	ID	Bus From	P Gen - [MW]	Q Gen - [MVAR]	Q Min - [MVAR]	Q Max - [MVAR]	
48	G06	B35	650.00	494.13	-192.00	448.00	
49	G07	B36	560.00	470.89	-168.00	392.00	
50							
51	TRANSFORMERS AT TAP LIMITS (WITHIN 0 %)						
52	ID	Bus From	Bus To	Tap Pos - [%]	Min Tap - [%]	Max Tap - [%]	

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TASK 5

<u>*Necessary Steps to solve the abnormalities of Task 4*</u>

1. We have added SVCs to buses 35 and 36 to solve the reactive power limit problem of generators 6 and 7.

2. An SVC is connected to bus 23 to which the induction motors are connected. Induction motors operate at lagging pf, so this measure improves the power factor of the whole system.

3. We have increased the active generation of the generators to decrease load from the swing bus, which was previously supplying the entire load of the induction motor. The overloading of transformer 3 is solved. The increase in active generation was done in small amounts by inspection and trial error, so that the total 800 MW increase in load can be compensated without any line overloads.

4. To solve the overloading of the remaining lines we have added SVCs to each end of those lines.

	ID	Bus ID	DBase ID	Duplic	Status	Generator Type	P Gen	Q Desired	Rotor Angle	Ground R	Ground X	Ctrled BusID	Ra
1	G01	B39	G01	1	☑	Voltage C	1140.000	0.000	0.00	730.000	0.100	B39	10000
2	G02	B31	G02	1	☑	Swing	0.000	0.000	0.00	730.000	0.100	B31	700
3	G03	B32	G03	1	☑	Voltage C	700.000	0.000	0.00	730.000	0.100	B32	800
4	G04	B33	G04	1	☑	Voltage C	650.000	0.000	0.00	730.000	0.100	B33	800
5	G05	B34	G05	2	☑	Voltage C	290.000	0.000	0.00	730.000	0.100	B34	300
6	G06	B35	G06	1	☑	Voltage C	750.000	0.000	0.00	730.000	0.100	B35	800
7	G07	B36	G07	1	☑	Voltage C	625.000	0.000	0.00	730.000	0.100	B36	700
8	G08	B37	G08	1	☑	Voltage C	600.000	0.000	0.00	730.000	0.100	B37	700
9	G09	B38	G09	1	☑	Voltage C	880.000	0.000	0.00	730.000	0.100	B38	1000
10	G10	B30	G10	1	☑	Voltage C	275.000	0.000	0.00	730.000	0.100	B30	1000
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

Induction Motor | Static Var Compensator | Generator

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	ID	Bus ID	DBase ID	Duplic	Status	Q	Ctrl'd Bus	L	Q Max	Q Min
1	SV1	B35	SV1	1	☑	3.000	B35	1.238	500.000	-200.000
2	SV2	B36	SV1	1	☑	3.000	B36	1.238	500.000	-200.000
3	SV3	B23	SV2	2	☑	3.000	B23	378.868	500.000	-500.000
4	SV4	B2	SV2	1	☑	3.000	B2	378.868	500.000	-500.000
5	SV5	B3	SV2	1	☑	3.000	B3	378.868	500.000	-500.000
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										

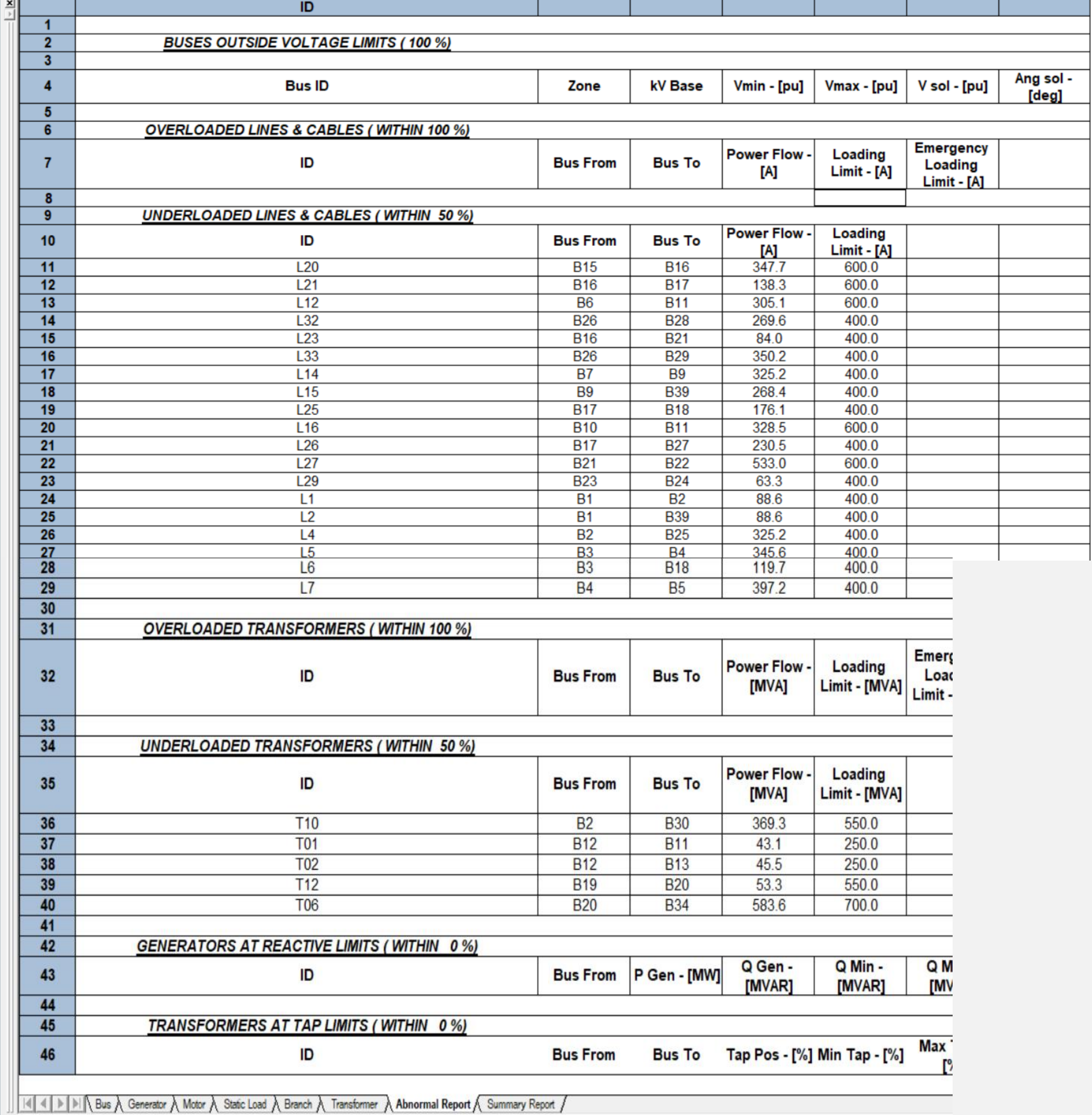
Induction Motor | Static Var Compensator

TASK 5

Necessary Steps to solve the abnormalities of Task 4

After modifying the network, all abnormalities and overloads of the system has been resolved.

Also, there are no warnings or red lines in any other parts of the report.



	ID						
1							
2	***BUSES OUTSIDE VOLTAGE LIMITS (100 %)***						
3							
4	**Bus ID**	**Zone**	**kV Base**	**Vmin - [pu]**	**Vmax - [pu]**	**V sol - [pu]**	**Ang sol - [deg]**
5							
6	***OVERLOADED LINES & CABLES (WITHIN 100 %)***						
7	**ID**	**Bus From**	**Bus To**	**Power Flow - [A]**	**Loading Limit - [A]**	**Emergency Loading Limit - [A]**	
8							
9	***UNDERLOADED LINES & CABLES (WITHIN 50 %)***						
10	**ID**	**Bus From**	**Bus To**	**Power Flow - [A]**	**Loading Limit - [A]**		
11	L20	B15	B16	347.7	600.0		
12	L21	B16	B17	138.3	600.0		
13	L12	B6	B11	305.1	600.0		
14	L32	B26	B28	269.6	400.0		
15	L23	B16	B21	84.0	400.0		
16	L33	B26	B29	350.2	400.0		
17	L14	B7	B9	325.2	400.0		
18	L15	B9	B39	268.4	400.0		
19	L25	B17	B18	176.1	400.0		
20	L16	B10	B11	328.5	600.0		
21	L26	B17	B27	230.5	400.0		
22	L27	B21	B22	533.0	600.0		
23	L29	B23	B24	63.3	400.0		
24	L1	B1	B2	88.6	400.0		
25	L2	B1	B39	88.6	400.0		
26	L4	B2	B25	325.2	400.0		
27	L5	B3	B4	345.6	400.0		
28	L6	B3	B18	119.7	400.0		
29	L7	B4	B5	397.2	400.0		
30							
31	***OVERLOADED TRANSFORMERS (WITHIN 100 %)***						
32	**ID**	**Bus From**	**Bus To**	**Power Flow - [MVA]**	**Loading Limit - [MVA]**	**Emerg Loac Limit -**	
33							
34	***UNDERLOADED TRANSFORMERS (WITHIN 50 %)***						
35	**ID**	**Bus From**	**Bus To**	**Power Flow - [MVA]**	**Loading Limit - [MVA]**		
36	T10	B2	B30	369.3	550.0		
37	T01	B12	B11	43.1	250.0		
38	T02	B12	B13	45.5	250.0		
39	T12	B19	B20	53.3	550.0		
40	T06	B20	B34	583.6	700.0		
41							
42	***GENERATORS AT REACTIVE LIMITS (WITHIN 0 %)***						
43	**ID**	**Bus From**	**P Gen - [MW]**	**Q Gen - [MVAR]**	**Q Min - [MVAR]**	**Q M [MV**	
44							
45	***TRANSFORMERS AT TAP LIMITS (WITHIN 0 %)***						
46	**ID**	**Bus From**	**Bus To**	**Tap Pos - [%]**	**Min Tap - [%]**	**Max [%**	

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THANK YOU FOR YOUR ATTENTION