Estimation and Analysis of Harmonics in a Bus System

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Abstract **Harmonics play an important role in regressing of the power quality. Generally harmonics are generated due to the presence of nonlinear loads and this can counter effect on the system. This paper deals with the estimation and analysis of harmonics in a power line network. In order to estimate the effect, the harmonics are been introduced for the bus system and harmonics analysis is been done. To mitigate the harmonics we use harmonic filters. We are using MiPower software to resolve this problem as this software has no limit on the number of buses in the system and is highly interactive. In this project, five bus systems is designed using MiPower software where harmonics have been injected to the buses and its effects are studied.**

Keywords - Power **quality, MiPower software, Load flow analysis, Harmonic analysis, Total Harmonic Distortion (THD)**

I. INTRODUCTION

In an electric power system, the harmonics means that current and voltage are been cockeyed and drifted from the sinusoidal wave. These are generated by the nonlinear loads such as rectifiers, discharge lighting, variable speed drivers, transistors etc. A load is said to be non-linear when the supply voltage does not match with the current it draws, where as the voltage harmonics are mostly caused due to current harmonics. Voltage harmonics are in miniature when correlated with current harmonics. The nonlinear loads majorly produce harmonics which are odd multiples of the fundamental frequency. The individual frequency element that involves a composite waveform is invoked as harmonic number (h). Harmonics lessens the level of power quality and reduces the efficiency of the system. In general, most of the systems can tolerate nonlinear loads up to 15% of the total electricity system capacity without any trouble [3]. Total harmonic distortion (THD) is an

index of a distortion of a signal and is the proportion among the rms value of all harmonics and rms of the fundamental frequency. The values of active power, reactive power and apparent power are to be illustrated thoroughly. The power factor is affected by the harmonics and also results in conductor losses, skin effect, resonances. It also leads to the damaging of the motors, generators, transformer windings as a result of overheating generated by harmonics [2]. Circuit breakers and fuses are also flawed thus resulting in reduction in the performance of the system. In order to mitigate the harmonics, harmonics filters are used.

II. MIPOWER SOFTWARE

MiPower software is an Indian based software and was developed by Dr.Nagrath a power systems engineer. It is a power systems analysis and computer aided software. Graphical User Interface (GUI) and database are the two essential components which are needed for the legitimate execution of network and to design any network. We will link the database with the graphical user interface and this generates a path so that we can enroll values to the components. The main advantage of this software is that the number of buses designed can be unlimited and it takes environmental conditions into the picture. It is user-friendly and highly interactive [3]. This software is used for different purpose of simulation like load flow analysis, harmonic analysis, short circuit analysis, voltage instability, fault occur in a line, bus and type of fault, and economic load dispatch [2],[4].

III. SIMULATION PROCESS

A Single Line Diagram for an n number of bus systems in MiPower software is drawn by configuring the database manager as a simulation file. Later on we can use the components of the bus system present in the MiPower software. To draw a bus, click on the symbol and draw it horizontally or vertically as required and a bus data window will pop up, where in nominal voltage is to be specified. Transmission line is to be drawn between the

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buses, so click on the icon and draw it from one end to another between the buses and in the transmission data pop window enters the values of De-rated MVA, structure reference number, positive sequence resistance, positive sequence reactance, and positive sequence susceptance accordingly. Now click on the generator icon and give it to the bus and generator data is to be given in the pop up window where in De-rated MVA, real power minimum, real power maximum, reactive power minimum, and reactive power maximum, MVA rating, MW rating, KW rating accordingly. Click on the load icon and attach it to the buses as required and a pop up window appears where load data such as real power in MW, reactive power in MVAR are to be given and compute these two to calculate the power factor. Now a RMS current source is attached to the buses and the harmonics are fed by specifying the harmonic numbers. Here we have injected harmonics to the buses 3, 4, 5. Where load flow analysis and harmonic analysis are studied as follows.

Load flow analysis can be achieved by Gauss seidel, Newton raphson, fast decoupled, DC load flow methods. We have selected Newton raphson method for feasible calculations of iteration method then we have to obtain generation is equal to the sum of load and loss, if not the given data or single line diagram is incorrect [7]. In harmonics analysis where average total harmonic distortion with respect to each bus is plotted against percentage distortion [1],[8].

IV. PROPOSED SYSTEM

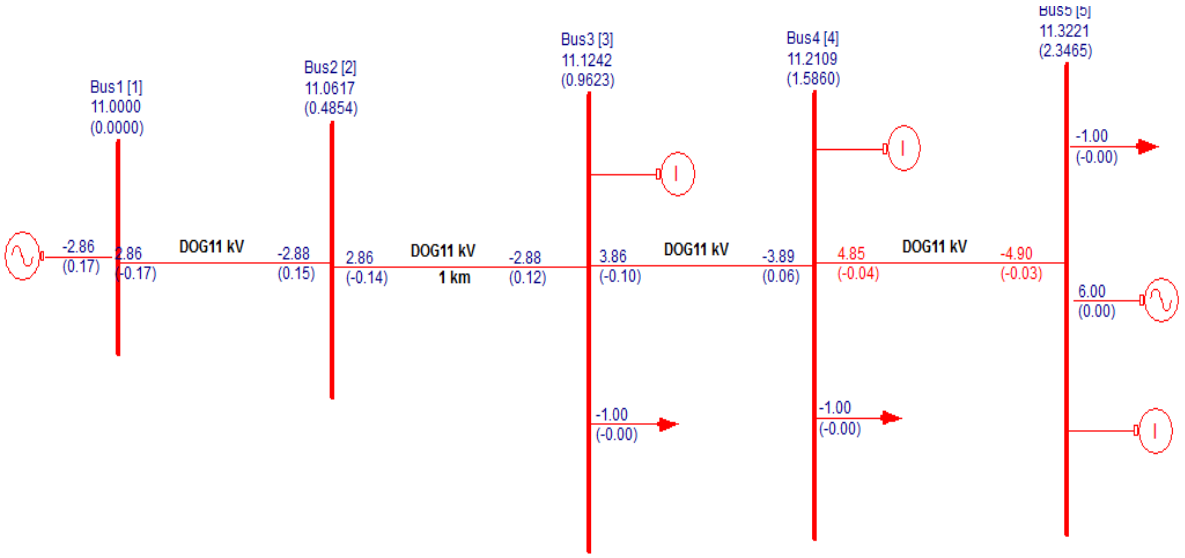

Figure 1 Single Line Diagram for Load flow & Harmonic Analysis

V. OUTPUTS

LOAD FLOW ANALYSIS

|::::: LOAD FLOW ANALYSIS :::::|
|-----CASE NO: 1 CONTINGENCY: 0 SCHEDULE NO : 0-----|
|-----CONTINGENCY NAME: Base Case RATING CONSIDERED: NOMINAL -----|

%% First Power System Network

|~~~~~ INPUT DATA ~~~~~|

|***** SYSTEM SPECIFICATION *****|

Largest Bus Number Used : 5
Actual Number of Buses : 5
Number of Transmission Lines : 4
Number of Generators : 2
Number of Loads : 3

Number of Zones : 1
Base MVA : 100.0
Nominal System Frequency (Hz) : 50.0
Q Checking Limit (Enabled) : 4
Real Power Tolerance (p.u.) : 0.00100
Reactive Power Tolerance (p.u.) : 0.00100
Maximum Number of Iterations : 15
Bus Voltage below which Load Model is changed : 0.7500
Transformer R/X Ratio : 0.05000

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|***** PRESENT WORTH ANALYSIS DATA *****|

Annual Percentage Interest Charges: 15.000
Annual Percent Operation & Maintenance Charges : 4.000
Life of Equipment (Years) : 20.000
Energy Unit Charge (kWh) : 2.500 Rs
Loss Load Factor : 0.300
Cost Per MVAr (Lakhs) : 5.000 Rs

|~~~~~ SYSTEM DATA ~~~~~|

|***** BUS DATA *****|

BUS NO.	AREA	ZONE	BUS kV	VMIN (p.u.)	VMAX (p.u.)	NAME
1	1	1	11.000	0.950	1.050	Bus1
2	1	1	11.000	0.950	1.050	Bus2
3	1	1	11.000	0.950	1.050	Bus3
4	1	1	11.000	0.950	1.050	Bus4
5	1	1	11.000	0.950	1.050	Bus5

|***** TRANSMISSION LINE DATA *****|

STA	CKT	FROM NODE	FROM NAME*	TO NODE	TO NAME*	LINE PARAMETER R(p.u.)	X(p.u.)	B/2(p.u.)	RATING KMS MVA
3	1	1	Bus1	2	Bus2	0.21240	0.28512	0.00000	5 1.00
3	1	2	Bus2	3	Bus3	0.21240	0.28512	0.00000	5 1.00
3	1	3	Bus3	4	Bus4	0.21240	0.28512	0.00000	5 1.00
3	1	4	Bus4	5	Bus5	0.21240	0.28512	0.00000	5 1.00

Total Line Charging Susceptance (p.u.) : 0.00002
Total Line Charging MVAr at 1 p.u. Voltage : 0.002
Number of Lines Opened on Both the Ends : 0
Total Line Charging susceptance of Existing Lines (p.u.) : 0.00002
Total Line Charging MVAr at 1 p.u. Voltage of Existing Lines: 0.002

Total Capacitive Susceptance : 0.00000 p.u. - 0.000 MVAr
Total Inductive Susceptance : 0.00000 p.u. - 0.000 MVAr

|***** GENERATOR DATA *****|

Sl.No*	FROM NODE	FROM NAME*	REAL POWER (MW)	Q-MIN MVAr	Q-MAX MVAr	V-SPEC p.u.	CAP. CURV	MVA STAT RATING
1	5	Bus5	6.0000	0.0000	4.5000	1.0000	0	7.50 3
2	1	Bus1	6.0000	0.0000	4.5000	1.0000	0	7.50 3

|***** LOAD DATA *****|

Sl.No.	FROM NODE	FROM NAME*	REAL MW	REACTIVE MVAR	COMP VALUE	COMPENSATING CHAR	F/V	MIN	MAX	STEP	NO.	NO.
1	4	Bus4	1.000	0.000	0.000	0.000	0.000	0.000	0	3	0	
2	3	Bus3	1.000	0.000	0.000	0.000	0.000	0.000	0	0	3	0
3	5	Bus5	1.000	0.000	0.000	0.000	0.000	0.000	0	0	3	0

|***** OUTPUT DATA *****|

Total Specified MW Load : 3.00000 Changed to 3.00000
Total Specified MVAr Load : 0.00000 Changed to 0.00000
Total Specified MVAr Compensation : 0.00000 Changed to 0.00000

Total (Including Out of Service Units)
Total Specified MW Generation : 12.00000
Total Minimum MVAr Limit of Generator : 0.00000
Total Maximum MVAr Limit of Generator : 9.00000
Total Specified MW Load : 3.00000 Changed to 3.00000
Total Specified MVAr Load : 0.00000 Changed to 0.00000
Total Specified MVAr Compensation : 0.00000 Changed to 0.00000

|----- GENERATOR DATA FOR FREQUENCY DEPENDENT LOAD FLOW -----|

SLNO*	FROM	FROM PARTICI	P-RATE	P-MIN	P-MAX	%DROOP	BIAS FACTOR	SETTING
1	5	Bus5	6.000	0.0000	6.0000	4.0000	0.0000	0.0000 0.0000 0.0000
2	1	Bus1	6.000	0.0000	6.0000	4.0000	0.0000	0.0000 0.0000 0.0000

Slack Bus Angle (degree) : 0.00

|~~~~~ OUTPUT RESULTS ~~~~~|

TOTAL NUMBER OF ISLANDS IN THE GIVEN SYSTEM : 1
TOTAL NUMBER OF ISLANDS HAVING ATLEAST ONE GENERATOR: 1

|----- SLACK BUSES CONSIDERED FOR THE STUDY -----|

ISLAND NO.	SLACK BUS NO.	SLACK BUS NAME	SPECIFIED MW
1	1	Bus1	6.000

|----- CONVERGENCE INDEX -----|

ITERATION COUNT	BUS NUMBER	MAX P PER UNIT	BUS NUMBER	MAX Q PER UNIT
1	5	0.050	4	0.005
2	5	0.013	4	0.000
3	5	0.004	2	0.000
4	5	0.001	2	0.000
5	5	0.000	5	0.025
6	5	0.023	5	0.010
7	5	0.001	5	0.000

Number of P Iterations: 5 and Number of Q Iterations: 6

|***** BUS VOLTAGES AND POWERS *****|

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NODE FROM V-MAG ANGLE MW MVAr MW MVAr
NO. NAME p.u. DEGREE GEN GEN LOAD LOAD COMP

1	Bus1	1.0000	0.00	-2.858	0.174	0.000	0.000	0.000
2	Bus2	1.0056	0.49	0.000	0.000	0.000	0.000	0.000
3	Bus3	1.0113	0.96	0.000	0.000	1.000	0.000	0.000
4	Bus4	1.0192	1.59	0.000	0.000	1.000	0.000	0.000
5	Bus5	1.0293	2.35	6.000	0.000	1.000	0.000	0.000

NUMBER OF BUSES EXCEEDING MINIMUM VOLTAGE LIMIT (@ mark): 0
NUMBER OF BUSES EXCEEDING MAXIMUM VOLTAGE LIMIT (# mark) : 0
NUMBER OF GENERATORS EXCEEDING MINIMUM Q LIMIT (< mark): 0
NUMBER OF GENERATORS EXCEEDING MAXIMUM Q LIMIT (> mark): 0

|***** LINE FLOWS AND LINE LOSSES *****|

SLNO CS FROM FROM TO TO FORWARD LOSS % NODE NAME NODE NAME MW MVAr MW MVAr LOADING

1	1	1	Bus1	2	Bus2	-2.858	0.174	0.0174	0.0230	62.9$
2	1	2	Bus2	3	Bus3	-2.864	0.140	0.0173	0.0228	62.6$
3	1	3	Bus3	4	Bus4	-3.859	0.101	0.0310	0.0411	83.9#
4	1	4	Bus4	5	Bus5	-4.855	0.038	0.0482	0.0643	104.6@

! NUMBER OF LINES LOADED BEYOND 125% : 0
@ NUMBER OF LINES LOADED BETWEEN 100% AND 125%: 1
# NUMBER OF LINES LOADED BETWEEN 75% AND 100%: 1
$ NUMBER OF LINES LOADED BETWEEN 50% AND 75%: 2
^ NUMBER OF LINES LOADED BETWEEN 25% AND 50%: 0
& NUMBER OF LINES LOADED BETWEEN 1% AND 25%: 0
* NUMBER OF LINES LOADED BETWEEN 0% AND 1%: 0

BUSES BETWEEN WHICH ANGLE DIFFERENCE IS > 30 degrees IS: ZERO

ISLAND FREQUENCY SLACK-BUS CONVERGED (1)

1	50.00000	1	1

|***** SUMMARY OF RESULTS *****|

TOTAL REAL POWER GENERATION (CONVENTIONAL) : 6.000 MW
TOTAL REAL POWER INJECTION (-ve LOAD) : 0.000 MW
TOTAL REACT. POWER GENERATION (CONVENTIONAL) : 0.174 MVAr
GENERATION p.f. : 1.000
TOTAL REAL POWER GENERATION (WIND) : 0.000 MW
TOTAL REACT. POWER GENERATION (WIND) : 0.000 MVAr
TOTAL REAL POWER GENERATION (SOLAR) : 0.000 MW
TOTAL REACT. POWER GENERATION (SOLAR) : 0.000 MVAr
TOTAL SHUNT REACTOR INJECTION : -0.000 MW
TOTAL SHUNT REACTOR INJECTION : -0.000 MVAr
TOTAL SHUNT CAPACIT.INJECTION : -0.000 MW
TOTAL SHUNT CAPACIT.INJECTION : -0.000 MVAr
TOTAL TCSC REACTIVE DRAWL : 0.000 MVAr
TOTAL SPS REACTIVE DRAWL : 0.000 MVAr
TOTAL UPFC INJECTION : -0.000 MVAr
TOTAL SHUNT FACTS INJECTION : 0.000 MVAr
TOTAL SHUNT FACTS DRAWAL : 0.000 MVAr
TOTAL REAL POWER LOAD : 3.000 MW
TOTAL REAL POWER DRAWAL (-ve gen.) : 2.858 MW
TOTAL REACTIVE POWER LOAD : 0.000 MVAr
LOAD p.f. : 1.000
TOTAL COMPENSATION AT LOADS : 0.000 MVAr
TOTAL HVDC REACTIVE POWER : 0.000 MVAr
TOTAL REAL POWER LOSS (AC+DC) : 0.113834 MW (0.113834+ 0.000000)
PERCENTAGE REAL LOSS (AC+DC) : 1.897
TOTAL REACTIVE POWER LOSS : 0.151154 MVAr

|----- ZONE WISE DISTRIBUTION -----|

Description	Zone # 1
MW generation	3.1420
MVAr generation	0.1742
MW wind gen.	0.0000
MVAr wind gen.	0.0000
MW solar gen.	0.0000
MVAr solar gen.	0.0000
MW load	3.0000
MVAr load	0.0000
MVAr compensation	0.0000
MW loss	0.1138
MVAr loss	0.1512
MVAr - inductive	0.0000
MVAr - capacitive	0.0000

|----- AREA WISE DISTRIBUTION -----|

Description	Area # 1
MW generation	3.1420
MVAr generation	0.1742
MW wind gen.	0.0000
MVAr wind gen.	0.0000
MW solar gen.	0.0000
MVAr solar gen.	0.0000
MW load	3.0000
MVAr load	0.0000
MVAr compensation	0.0000
MW loss	0.1138
MVAr loss	0.1512
MVAr - inductive	0.0000
MVAr - capacitive	0.0000

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GRAPH OF TOTALHARMONIC DISTOTRION

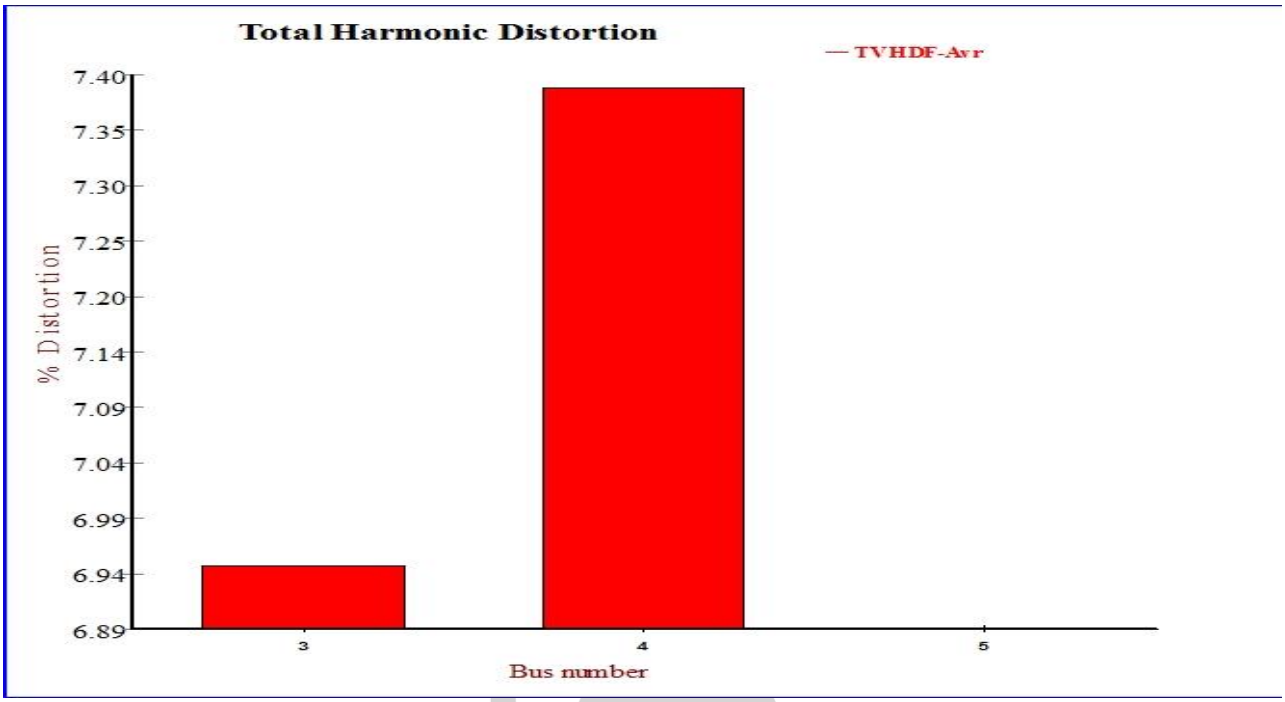

Figure 2 Total Harmonic Distortion

HARMONIC ANALYSIS
CASE NO : 1 SCHEDULE NO : 0

%% First Power System Network
LARGEST BUS NUMBER USED : 5
ACTUAL NUMBER OF BUSES : 5

NUMBER OF ELEMENTS IN RX_B2 FORMAT: 4
NUMBER OF GENERATORS : 2
NUMBER OF LOADS : 3
NUMBER OF RMS V/I SOURCES : 1

BASE MVA : 100.000
NOMINAL SYSTEM FREQUENCY : 50.000
INITIAL VOLTAGE OF 1 P.U. IS ASSUMED
NUMBER OF ZONES : 1
PRINT OPTION : 3
BOTH DATA AND RESULT APPEAR IN THE REPORT FILE
PLOT OPTION : 1
PLOT FILES ARE GENERATED

NUMBER OF HARMONIC ORDERS: 5
HARMONIC ORDERS : 2 3 4 5 6

NUMBER OF BUSES OF INTEREST: 3
BUS NUMBERS : 3 4 5

TRANSFOMRER R/X RATIO : 0.05000

CIRCUIT BREAKER R-PU : 0.00000
CIRCUIT BREAKER X-PU : 0.00010
NUMBER OF LINE TYPES 3x3 : 0
NUMBER OF LINE TYPES 6x6 : 0

NUMBER OF LINE TYPES 12x12 : 0

BUSNO STATUS ZONE BUSVOLT KV BUS NAME VOLT-MAG ANG-DEG
---- ------ ---- --------- -------- -------- --------
1 1 1 11.000 Bus1 1.0000 0.000
2 1 1 11.000 Bus2 1.0000 0.000
3 1 1 11.000 Bus3 1.0000 0.000
4 1 1 11.000 Bus4 1.0000 0.000
5 1 1 11.000 Bus5 1.0000 0.000

R, X, B/2 DATA
STATUS FROM FROM TO TO POSITIVE/ZERO BUS NAME BUS NAME R(P.U) X(P.U.) B/2(P.U) LENGTH
------ ---------- ---- -------- -------- -------
3 1 Bus1 2 Bus2 0.21240 0.28512 0.00000 0.33471 1.30579 0.00000 1.00000
3 2 Bus2 3 Bus3 0.21240 0.28512 0.00000 0.33471 1.30579 0.00000 1.00000
3 3 Bus3 4 Bus4 0.21240 0.28512 0.00000 0.33471 1.30579 0.00000 1.00000
3 4 Bus4 5 Bus5 0.21240 0.28512 0.00000 0.33471 1.30579 0.00000 1.00000

GENERATOR CONNECTION DATA

FROM FROM POSITIVE NEGATIVE ZERO STATUS
BUS NAME R(P.U) X(P.U.) R(P.U.) X(P.U.) R(P.U.) X(P.U.)
---- -------- --------- --------- --------- --------- -
5 Bus5 0.01333 3.37333 0.01333 3.84000 0.01333 1.333333
1 Bus1 0.01333 3.37333 0.01333 3.84000 0.01333 1.333333

VOLTAGE/CURRENT SOURCE DATA
CURRENT SOURCE BUS : 4 (TYPE - 1)

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COUNT PHASE A PHASE B PHASE C AMP-RMS ANGLE-DEG AMP-RMS ANGLE-DEG AMP-RMS ANGLE-DEG

2	28.169	0.000	28.169	120.000	28.169	240.000
3	32.193	0.000	32.193	120.000	32.193	240.000
4	16.096	0.000	16.096	120.000	16.096	240.000
5	24.144	0.000	24.144	120.000	24.144	240.000
6	0.000	0.000	0.000	120.000	0.000	240.000

BUS A-P-MW A-Q-MVAR B-P-MW B-QMVAR C-P-MW C-Q-MVAR MD STATUS

4	0.333	0.000	0.333	0.000	0.333	0.000	0	3
3	0.333	0.000	0.333	0.000	0.333	0.000	0	3
5	0.333	0.000	0.333	0.000	0.333	0.000	0	3

INJECTED 2th HARMONIC CURRENT IN AMPs AND DEGREE FOR A, B AND C PHASES

BUS NAME C-A-AMP A-A-DEGR C-B-AMP A-B-DEGR C-C-AMP A-C-DEGR

1	Bus1	0.000	-90.000	0.000	-90.000	0.000 -90.000
2	Bus2	0.000	-90.000	0.000	-90.000	0.000 -90.000
3	Bus3	0.000	-90.000	0.000	-90.000	0.000 -90.000
4	Bus4	28.169	0.000	28.169	120.000	28.169 -120.000
5	Bus5	0.000	-90.000	0.000	-90.000	0.000 -90.000

2th HARMONIC BUS VOLTAGES IN VOLTS-DEGREE FOR A, B AND C PHASES

BUS NAME V-A-VOLT V-A-DEGR V-B-VOLT V-B-DEGR V-C-VOLT V-C-DEGR

1	Bus1	122.332	91.177	122.340	-148.826	122.341 -28.821
2	Bus2	131.464	89.709	131.473	-150.293	131.473 -30.289
3	Bus3	140.671	88.433	140.680	-151.569	140.679 -31.565
4	Bus4	149.938	87.314	149.947	-152.688	149.946 -32.684
5	Bus5	139.522	88.781	139.531	-151.221	139.531 -31.216

2th HARMONIC LINE FLOWS IN AMPS-DEGREE FOR A, B AND C PHASES

FROM NAME TO NAME I-A-AMP I-A-DEGR I-B-AMP I-B-DEGR I-C-AMP I-C-DEGR

1	Bus1	2	Bus2	13.165	-178.724	13.165	-58.724	13.165 61.276
13.164	1.276	13.164	121.276	13.164	-118.724			
2	Bus2	3	Bus3	13.164	-178.724	13.164	-58.724	13.164 61.276
13.163	1.276	13.163	121.276	13.163	-118.724			
3	Bus3	4	Bus4	13.163	-178.724	13.163	-58.724	13.163 61.276
13.162	1.277	13.162	121.276	13.162	-118.723			
4	Bus4	5	Bus5	15.014	-1.119	15.014	118.881	15.014 -121.119
15.015	178.881	15.015	-61.119	15.014	58.881			

2th HARMONIC SHUNT INJECTIONS IN AMPS-DEGREE FOR A, B AND C PHASES

BUS NAME I-A-AMP I-A-DEGR I-B-AMP I-B-DEGR I-C-AMP I-C-DEGR

5	Bus5	15.015	178.881	15.015	-61.119	15.015 58.881
1	Bus1	13.165	-178.724	13.165	-58.724	13.165 61.276
4	Bus4	0.000	-90.000	0.000	-90.000	0.000 -90.000
3	Bus3	0.000	-90.000	0.000	-90.000	0.000 -90.000
5	Bus5	0.000	-90.000	0.000	-90.000	0.000 -90.000

INJECTED 3th HARMONIC CURRENT IN AMPs AND DEGREE FOR A, B AND C PHASES

BUS NAME C-A-AMP A-A-DEGR C-B-AMP A-B-DEGR C-C-AMP A-C-DEGR

1	Bus1	0.000	-90.000	0.000	-90.000	0.000 -90.000
2	Bus2	0.000	-90.000	0.000	-90.000	0.000 -90.000
3	Bus3	0.000	-90.000	0.000	-90.000	0.000 -90.000
4	Bus4	32.193	0.000	32.193	120.000	32.193 -120.000
5	Bus5	0.000	-90.000	0.000	-90.000	0.000 -90.000

3th HARMONIC BUS VOLTAGES IN VOLTS-DEGREE FOR A, B AND C PHASES

BUS NAME V-A-VOLT V-A-DEGR V-B-VOLT V-B-DEGR V-C-VOLT V-C-DEGR

1	Bus1	209.849	90.785	209.864	-149.218	209.864 -29.213
2	Bus2	225.468	89.806	225.483	-150.196	225.483 -30.192
3	Bus3	241.141	88.955	241.156	-151.047	241.156 -31.043
4	Bus4	256.858	88.207	256.873	-151.794	256.873 -31.790
5	Bus5	239.065	89.186	239.080	-150.816	239.080 -30.812

3th HARMONIC LINE FLOWS IN AMPS-DEGREE FOR A, B AND C PHASES

FROM NAME TO NAME I-A-AMP I-A-DEGR I-B-AMP I-B-DEGR I-C-AMP I-C-DEGR

1	Bus1	2	Bus2	15.055	-179.149	15.055	-59.149	15.055 60.851
15.053	0.851	15.053	120.851	15.053	-119.149			
2	Bus2	3	Bus3	15.053	-179.149	15.053	-59.149	15.053 60.851
15.050	0.851	15.050	120.851	15.050	-119.148			
3	Bus3	4	Bus4	15.050	-179.149	15.050	-59.149	15.050 60.852
15.048	0.852	15.048	120.852	15.048	-119.148			
4	Bus4	5	Bus5	17.149	-0.748	17.149	119.253	17.149 -120.748
17.151	179.252	17.151	-60.747	17.151	59.252			

3th HARMONIC SHUNT INJECTIONS IN AMPS-DEGREE FOR A, B AND C PHASES

BUS NAME I-A-AMP I-A-DEGR I-B-AMP I-B-DEGR I-C-AMP I-C-DEGR

5	Bus5	17.151	179.252	17.151	-60.747	17.151 59.252
1	Bus1	15.055	-179.149	15.055	-59.149	15.055 60.851
4	Bus4	0.000	-90.000	0.000	-90.000	0.000 -90.000
3	Bus3	0.000	-90.000	0.000	-90.000	0.000 -90.000
5	Bus5	0.000	-90.000	0.000	-90.000	0.000 -90.000

INJECTED 4th HARMONIC CURRENT IN AMPs AND DEGREE FOR A, B AND C PHASES

BUS NAME C-A-AMP A-A-DEGR C-B-AMP A-B-DEGR C-C-AMP A-C-DEGR

1	Bus1	0.000	-90.000	0.000	-90.000	0.000 -90.000
2	Bus2	0.000	-90.000	0.000	-90.000	0.000 -90.000
3	Bus3	0.000	-90.000	0.000	-90.000	0.000 -90.000
4	Bus4	16.096	0.000	16.096	120.000	16.096 -120.000
5	Bus5	0.000	-90.000	0.000	-90.000	0.000 -90.000

4th HARMONIC BUS VOLTAGES IN VOLTS-DEGREE FOR A, B AND C PHASES

BUS NAME V-A-VOLT V-A-DEGR V-B-VOLT V-B-DEGR V-C-VOLT V-C-DEGR

1	Bus1	139.954	90.593	139.964	-149.410	139.964 -29.405
2	Bus2	150.359	89.854	150.369	-150.148	150.369 -30.144
3	Bus3	160.782	89.211	160.793	-150.791	160.792 -30.787
4	Bus4	171.221	88.647	171.231	-151.355	171.231 -31.351
5	Bus5	159.372	89.386	159.382	-150.617	159.382 -30.612

4th HARMONIC LINE FLOWS IN AMPS-DEGREE FOR A, B AND C PHASES

FROM NAME TO NAME I-A-AMP I-A-DEGR I-B-AMP I-B-DEGR I-C-AMP I-C-DEGR

1	Bus1	2	Bus2	7.530	-179.358	7.530	-59.358	7.530 60.642
7.529	0.642	7.529	120.642	7.529	-119.357			
2	Bus2	3	Bus3	7.528	-179.358	7.528	-59.358	7.528 60.643
7.526	0.643	7.526	120.643	7.526	-119.357			
3	Bus3	4	Bus4	7.526	-179.357	7.526	-59.357	7.526 60.643
7.524	0.643	7.524	120.643	7.524	-119.357			

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4 Bus4 5 Bus5 8.573 -0.565 8.573 119.436 8.573 -120.565 8.575 179.435 8.575 -60.565 8.575 59.435

4th HARMONIC SHUNT INJECTIONS IN AMPS-DEGREE FOR A, B AND C PHASES

BUS NAME I-A-AMP I-A-DEGR I-B-AMP I-B-DEGR I-C-AMP I-C-DEGR

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5 Bus5 8.575 179.435 8.575 -60.565 8.575 59.435
1 Bus1 7.531 -179.358 7.531 -59.358 7.531 60.642
4 Bus4 0.000 -90.000 0.000 -90.000 0.000 -90.000
3 Bus3 0.000 -90.000 0.000 -90.000 0.000 -90.000
5 Bus5 0.000 -90.000 0.000 -90.000 0.000 -90.000

INJECTED 5th HARMONIC CURRENT IN AMPs AND DEGREE FOR A, B AND C PHASES

BUS NAME C-A-AMP A-A-DEGR C-B-AMP A-B-DEGR C-C-AMP A-C-DEGR

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1 Bus1 0.000 -90.000 0.000 -90.000 0.000 -90.000
2 Bus2 0.000 -90.000 0.000 -90.000 0.000 -90.000
3 Bus3 0.000 -90.000 0.000 -90.000 0.000 -90.000
4 Bus4 24.144 0.000 24.144 120.000 24.144 -120.000
5 Bus5 0.000 -90.000 0.000 -90.000 0.000 -90.000

5th HARMONIC BUS VOLTAGES IN VOLTS-DEGREE FOR A, B AND C PHASES

BUS NAME V-A-VOLT V-A-DEGR V-B-VOLT V-B-DEGR V-C-VOLT V-C-DEGR

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1 Bus1 262.518 90.483 262.537 -149.520 262.537 -29.515
2 Bus2 282.024 89.882 282.043 -150.121 282.043 -30.116
3 Bus3 301.549 89.359 301.568 -150.643 301.568 -30.639
4 Bus4 321.087 88.900 321.106 -151.102 321.106 -31.098
5 Bus5 298.879 89.501 298.898 -150.502 298.898 -30.497

5th HARMONIC LINE FLOWS IN AMPS-DEGREE FOR A, B AND C PHASES

FROM NAME TO NAME I-A-AMP I-A-DEGR I-B-AMP I-B-DEGR I-C-AMP I-C-DEGR

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1 Bus1 2 Bus2 11.300 -179.478 11.300 -59.478 11.300 60.523 11.296 0.523 11.296 120.522 11.296 -119.477
2 Bus2 3 Bus3 11.295 -179.477 11.295 -59.478 11.295 60.523 11.290 0.523 11.291 120.523 11.291 -119.477
3 Bus3 4 Bus4 11.290 -179.477 11.290 -59.477 11.290 60.523 11.285 0.524 11.285 120.523 11.285 -119.476
4 Bus4 5 Bus5 12.860 -0.460 12.860 119.541 12.860 -120.460 12.865 179.540 12.865 -60.460 12.865 59.540

5th HARMONIC SHUNT INJECTIONS IN AMPS-DEGREE FOR A, B AND C PHASES

BUS NAME I-A-AMP I-A-DEGR I-B-AMP I-B-DEGR I-C-AMP I-C-DEGR

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5 Bus5 12.866 179.540 12.865 -60.460 12.865 59.540
1 Bus1 11.300 -179.478 11.300 -59.478 11.300 60.523
4 Bus4 0.000 -90.000 0.000 -90.000 0.000 -90.000
3 Bus3 0.000 -90.000 0.000 -90.000 0.000 -90.000
5 Bus5 0.000 -90.000 0.000 -90.000 0.000 -90.000

INJECTED 6th HARMONIC CURRENT IN AMPs AND DEGREE FOR A, B AND C PHASES

BUS NAME C-A-AMP A-A-DEGR C-B-AMP A-B-DEGR C-C-AMP A-C-DEGR

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1 Bus1 0.000 -90.000 0.000 -90.000 0.000 -90.000
2 Bus2 0.000 -90.000 0.000 -90.000 0.000 -90.000
3 Bus3 0.000 -90.000 0.000 -90.000 0.000 -90.000
4 Bus4 0.000 -90.000 0.000 -90.000 0.000 -90.000
5 Bus5 0.000 -90.000 0.000 -90.000 0.000 -90.000

6th HARMONIC BUS VOLTAGES IN VOLTS-DEGREE FOR A, B AND C PHASES

BUS NAME V-A-VOLT V-A-DEGR V-B-VOLT V-B-DEGR V-C-VOLT V-C-DEGR

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1 Bus1 0.000 -90.000 0.000 -90.000 0.000 -90.000
2 Bus2 0.000 -90.000 0.000 -90.000 0.000 -90.000
3 Bus3 0.000 -90.000 0.000 -90.000 0.000 -90.000
4 Bus4 0.000 -90.000 0.000 -90.000 0.000 -90.000
5 Bus5 0.000 -90.000 0.000 -90.000 0.000 -90.000

6th HARMONIC LINE FLOWS IN AMPS-DEGREE FOR A, B AND C PHASES

FROM NAME TO NAME I-A-AMP I-A-DEGR I-B-AMP I-B-DEGR I-C-AMP I-C-DEGR

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1 Bus1 2 Bus2 0.000 -90.000 0.000 -90.000 0.000 -90.000 0.000 -90.000 0.000 -90.000 0.000 -90.000
2 Bus2 3 Bus3 0.000 -90.000 0.000 -90.000 0.000 -90.000 0.000 -90.000 0.000 -90.000 0.000 -90.000
3 Bus3 4 Bus4 0.000 -90.000 0.000 -90.000 0.000 -90.000 0.000 -90.000 0.000 -90.000 0.000 -90.000
4 Bus4 5 Bus5 0.000 -90.000 0.000 -90.000 0.000 -90.000 0.000 -90.000 0.000 -90.000 0.000 -90.000

6th HARMONIC SHUNT INJECTIONS IN AMPS-DEGREE FOR A, B AND C PHASES

BUS NAME I-A-AMP I-A-DEGR I-B-AMP I-B-DEGR I-C-AMP I-C-DEGR

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5 Bus5 0.000 -90.000 0.000 -90.000 0.000 -90.000
1 Bus1 0.000 -90.000 0.000 -90.000 0.000 -90.000
4 Bus4 0.000 -90.000 0.000 -90.000 0.000 -90.000
3 Bus3 0.000 -90.000 0.000 -90.000 0.000 -90.000
5 Bus5 0.000 -90.000 0.000 -90.000 0.000 -90.000

VOLTAGE HARMONIC DISTORTION FACTORS

NODE NAME %HDF-A %HDF-B %HDF-C %HDF-AVR

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1 Bus1 6.0474 6.0479 6.0479 6.0477
2 Bus2 6.4972 6.4977 6.4977 6.4975
3 Bus3 6.9482 6.9487 6.9486 6.9485
4 Bus4 7.4001 7.4005 7.4005 7.4004
5 Bus5 6.8878 6.8882 6.8882 6.8881

INDIVIDUAL VOLTAGE HARMONIC DISTORTION FACTORS

NODE NAME %HDF-T %HDF-2 %HDF-3 %HDF-4 %HDF-5 %HDF-6

---- -------- -------- -------- -------- --------

1 Bus1 6.0477 1.9263 3.3044 2.2038 4.1338 0.0000
2 Bus2 6.4975 2.0701 3.5504 2.3676 4.4409 0.0000
3 Bus3 6.9485 2.2151 3.7971 2.5318 4.7484 0.0000
4 Bus4 7.4004 2.3610 4.0446 2.6961 5.0560 0.0000
5 Bus5 6.8881 2.1970 3.7645 2.5096 4.7063 0.0000

TELEPHONE INFLUENCE FACTORS

NODE NAME %TIF-A %TIF-B %TIF-C %TIF-AVR

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1 Bus1 6215 6215 6215 6215
2 Bus2 6677 6677 6677 6677
3 Bus3 7139 7140 7140 7140
4 Bus4 7603 7603 7603 7603
5 Bus5 7077 7077 7077 7077

I-THD and RMS current for series branches

FROM NAME TO NAME RMS-HARMONIC(A) FUNDAMENTAL(A) RMS-TOTAL(A) I-THD(%)

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1 Bus1 2 Bus2 24.173615 0.010606 24.173618 227925.584

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2	Bus2	3	Bus3	24.168743	0.010606	24.168746
227879.649						
3	Bus3	4	Bus4	24.163524	0.010606	24.163526
227830.438						
4	Bus4	5	Bus5	27.538405	0.010606	27.538407
259651.151						

VI. CONCLUSION

This paper carried out the Load flow analysis and Harmonic analysis in a power system. Effect of the harmonics on each bus system is carried out with specified parameters are been studied. This analysis helps us to come to a conclusion on which filter is to be approved to mitigate the harmonics. The results obtained from the software are accurate and precise. This software has given us the results in a short Period.

The total real power generation (conventional) is 6.000MW of two generators, MW generation is 3.1420 and MW load is 3.0000 and MW loss is 0.1138. so from above we can conclude that generation is equal to the sum of load and loss. For the Evaluation of Harmonic Analysis five numbers of Harmonic orders are acknowledged, where in harmonic current, harmonic bus voltage, harmonic line flow, harmonic shunt injection are assessed. From the graph, the highest percentage distortion with respect to the bus is ascertained. This is by virtue of RMS current source supplying the harmonics is connected to the Bus system.

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