ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor & UGC Approved Journal)

Website: www.ijareeie.com

Vol. 6, Issue 9, September 2017

Evaluation of Reliability Indices and Improvement using DG of a Rural Radial Distribution Feeder

Prakash T[1], Dr. K Thippeswamy[2]

Research Scholar, Dept of Electrical and Electronics, DACG (Govt) Polytechnic, Chikkamagaluru, India

Selection grade Lecturer, Dept of Electrical and Electronics, S J (Govt) Polytechnic, Bengaluru, India

ABSTRACT: for the growing demand of electricity day by day electric utility companies are struggling to provide adequate and reliable power supply. Reliability is one of the major issues in power distribution system. The basic reliability indices and customer oriented reliability indices estimation is helpful in analyzing the system failure and also helps in future prediction analysis. Here calculation of reliability indices is done in two stages. In the first stage indices are calculated on the past performance of arrangement. In the second stage the indices are calculated after placing the Distributed Generator. The daily outage data on monthly basis is collected for the vastare feeder from chikkamagaluru MUSS for the years 2014, 2015 and 2016. The various reliability indices are calculated and studied. The outages are classified as scheduled and unscheduled. The average failure rate and availability of vastare feeder is 0.13 and 0.74. Distribution Generator will improve the reliability. The optimal location of DG placed in vastare feeder and reliability indices are calculated and studied. The study shows that reliability will be improved after placing DG.

KEYWORDS: reliability; distribution generator; average availability.

I. INTRODUCTION

Power system mainly comprise of generation, transmission and distribution. Out of these three components of power system the most affected component is the distribution. The power system basic function is to supply reliable electric power to consumers with economic price. Now a day with growing population the demand for electric power is also increasing tremendously. To meet the growing demand the utilities are struggling hard to meet the adequate and reliable power supply and utilities have to evolve new techniques and methods to achieve this. The past study reveals that the importance given to distribution is less compared to other two i.e., Generation and Transmission. The generation and transmission attracts huge capital whereas distribution is localized and is cheap compared with other two. However study of customer faults reveals that the greatest contribution of failure to customers is by distribution and others two are fewer contributors. Reliability can be defined as it is a measure of the ability of a system, generally given as numerical indices, to deliver power to all points of utilization within acceptable standards and in amounts desired. Power system reliability (comprising generation and transmission & distribution facilities) can be described by two basic functional attributes: adequacy and security. The different challenges that power sector facing mainly are the environment concern, power supply security and competitiveness. These are the factors which are driving the system for insertion of Distributed Generation (or DG). Distributed generation generally refers to capacity of 1 kW to 50MW which generates power close to customers place or DG can be linked to the existing distribution network. Distributed generators include micro turbines, induction generators, synchronous generators, solar photovoltaic, wind turbines, fuel cells and many more in recent times Distributed power generation has gained a lot of attention as the advanced technology in distributed generation and conventional power generation. Also it very important to place the DG in appropriate place to minimize the power loss and to increase voltage regulation. Chikkamagaluru MUSS comprising of twelve 11kV feeders. Out of twelve feeders the vastare feeder is taken for study and analysis for 3 years namely 2014, 2015 and 2016.The study and analysis of outages of the vastare feeder is useful in planning, design operation and maintenance [4]. According to improving distribution system is the key to improving reliability of supply to customers.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor & UGC Approved Journal)

Website: www.ijareeie.com

Vol. 6, Issue 9, September 2017

DISTRIBUTION INDICES:
The most common distribution indices include SAIDI, SAIFI CAIDI, ASUI and ASAI [5]. Reference [6] also cited for general application. We will review each of these indices with an example of how to use them.

i. **System Average Interruption Duration Index (SAIDI)**:
The most often used performance measurement for a sustained interruption is the System Average Interruption Duration Index(SAIDI).This index measures the total duration of an interruption for the average customer during a given time period. SAIDI is normally calculated on either monthly or yearly basis; however, it can also be calculated daily, or for any other time period. In this paper all indices are calculated on monthly Basis.
SAIDI = Sum of all customer interruption durations /Total Number of customers served

ii. System average interruption frequency index (SAIFI): it is the average number of the times that the customer experiences outage during that particular time**.**
SAIFI = Total number of customer interruptions / Total Number of customers served.
iii. Customer Average Interruption Duration Index (CAIDI): It is the ratio of system Average Interruption Duration Index (SAIDI) to the System Average Interruption frequency index (SAIFI). This ratio gives the average customer out of supply.
CAIDI = SAIDI / SAIFI

iv. The Average Service Availability Index (ASAI): It is the ratio of the total number of customers hours that service was available during a given period of the total customer hours demanded. This is sometimes called the service reliability index. The ASAI is usually calculated on either a monthly basis (730 hours) or a yearly basis (8,760 hours), but can be calculated for any time period.
ASAI = SAIDI / 8760

v. Average service unavailability Index (ASUI): It is the ratio of the outage hours to the total hours demanded for a particular time period.
ASAI = 1-ASUI
The most important factor for this function to be used is that the hazard rate (λ) should be constant known as failure rate (λ).
Reference [7] gave the density function as follows

$$f(t) = \lambda e^{-\lambda t}$$

And the hazard rate is given by

$$\lambda(t) = \frac{F(t)}{1 - f(t)}$$

Failure Rate (λ)

λ = number of times that failure occurred/number of unit-hours of operation

And the reliability distribution function is given by

$$R(t) = 1 - f(t) = e^{\lambda t}$$

Further reliability parameters given by are as follows:
Mean Time between Failure (MTBF)

MTBF = Total system operating hours/number of failures

Also Mean Time to Repair (MTTR) or Mean Down Time (MDT)

MTTR=total duration of outages/frequency of outages

Availability (A) = MTBF-MTTR/MTBF

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor & UGC Approved Journal)

Website: www.ijareeie.com

Vol. 6, Issue 9, September 2017

II. METHODOLOGY

The main objective of this paper is to improve the reliability of the distribution system by incorporating reliability analysis with the planned approach. The basic reliability indices and customer oriented reliability indices are calculated for the three years 2014, 2015 and 2016.For this case study an 11kV vastare radial distribution feeder originated from chikkamagaluru MUSS is selected. The basic reliability indices namely failure rate, MTBF, MDT, availability and the customer oriented reliability indices namely SAIFI, SAIDI, CAIDI, ASAI and ASUI are analyzed for the month of January to December for three years. For calculating above indices frequency of outages, duration of outages for each month and the number of customers served on this vastare feeder is collected. The reliability of vastare feeder can be improved by improving the reliability indices. The distribution generators are the solution for the power outages and they can improve the voltage regulation. The best placing of the distribution generator in an existing distribution feeder is very important factor here to improve the reliability. To find out the best placement and sizing of distribution generator, simulation software MATLAB program used which analyses the given practical line data and load data and suggests the bus number and size of the DG to be placed.

The reliability indices are again calculated after placing the distributed generator and analyzed. As the customers affected are reduced once they are connected with distributed generator the reliability indices will improve and hence system reliability.
The results are shown in Tables 1 to 15.

III. RESULTS AND DISCUSSIONS

The frequency and duration of outages, basic reliability indices and customer oriented indices are tabulated form Table 5 to7 for the year 2016.

The statistical data also collected for the years 2014 and 2015 for the vastare feeder. The Tables 1 to 4 shows the summarized basic reliability indices and customer oriented indices.

The vastare feeder had 1149, 1094 and 1104 interruptions in the years 2014, 2015 and 2016 respectively and the duration of outage in hours is 2045.47, 2308.13 and 2626.16 respectively. The failure rate is 0.13, 0.12 and 0.12 for the years 2014, 2015 and 2016 respectively. For the analyzed period the failure rate is high for the year 2014.In the years 2015 and 2016 the failure rate is high during the months September for the year 2015 and June for the year 2016. The availability factor for the three analyzed years is 0.76, 0.73, and 0.70 respectively. Most of the outages occurred are due to load shedding.

Failure rate	MTBF	MDT(Hr)	Availability
0.13	8.26	1.82	0.76

TABLE 1. SUMMARY OF BASIC RELIABILITY INDICES FOR THE YEAR 2014

SAIDI	SAIFI	CAIDI	ASAI	ASUI
2045.79	1149	1.82	0.76	0.23

TABLE 2. SUMMARY OF CUSTOMER ORIENTED RELIABILITY INDICES FOR THE YEAR 2014

Failure rate	MTBF	MDT(Hr)	Availability
0.12	8.68	2.20	0.73

Copyright to IJAREEIE

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor & UGC Approved Journal)

Website: www.ijareeie.com

Vol. 6, Issue 9, September 2017

TABLE 3. SUMMARY OF BASIC RELIABILITY INDICES FOR THE YEAR 2015

SAIDI	SAIFI	CAIDI	ASAI	ASUI
2308.23	1094	2.20	0.73	0.26

TABLE 4. SUMMARY OF CUSTOMER ORIENTED RELIABILITY INDICES FOR THE YEAR 2015

Months	Scheduled Outage		Forced Outage		Total outage	
	Freq	Duration(Hr)	freq	Duration(Hr)	freq	Duration(Hr)
Jan	63	248:33	22	3:37	85	252:10
Feb	68	258:07	18	12:26	86	270:33
Mar	91	285:28	23	5:25	114	290:53
Apr	75	269:35	23	8:23	98	277:58
May	67	217:28	55	49:23	122	266:51
Jun	68	173:56	70	50:17	138	224:13
Jul	29	18:56	34	34:29	63	53:25
Aug	32	55:09	17	15:43	49	70:52
Sep	43	169:00	12	1:38	55	170:38
Oct	58	176:32	21	5:52	79	182:24
Nov	68	257:38	26	19:09	94	276:47
Dec	84	266:50	37	22:42	121	289:32
TOTAL	**746**	**2397:12:00**	**358**	**229:04:00**	**1104**	2626:16

TABLE 5. SUMMARY OF FREQUENCY AND DURATION OF OUTAGES ON VASTARE FEEDER OF CHIKKAMAGALURU MUSS FROM JANUARY TO DECEMBER 2016

MONTHS	FREQUENCY	OUTAGE	TOTAL(HR)	FAILURE RATE(event/hr)	MTBF	MDT(Hr)	Availability(pu)
Jan	85	259.68	744	0.1142	8.7529	3.0551	0.6510
Feb	86	264.65	672	0.1280	7.8140	3.0773	0.6062
Mar	114	287.48	744	0.1532	6.5263	2.5218	0.6136
Apr	98	274.47	720	0.1361	7.3469	2.8007	0.6188
May	122	284.08	744	0.1640	6.0984	2.3285	0.6182
Jun	138	245.33	720	0.1917	5.2174	1.7778	0.6593
Jul	63	96.88	744	0.0847	11.8095	1.5378	0.8698
Aug	49	135.22	744	0.0659	15.1837	2.7596	0.8183
Sep	55	186.93	720	0.0764	13.0909	3.3987	0.7404
Oct	79	173.62	744	0.1062	9.4177	2.1977	0.7666
Nov	94	267.75	720	0.1306	7.6596	2.8484	0.6281
Dec	121	254.48	744	0.1626	6.1488	2.1031	0.6580
TOTAL	1104	2730.57	8760	0.126125	8.755505	2.533875	0.687342

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor & UGC Approved Journal)

Website: www.ijareeie.com

Vol. 6, Issue 9, September 2017

TABLE 6. COMPUTED BASIC RELIABILITY INDICES ON VASTARE FEEDER OF CHIKKAMAGALURU MUSS FROM JANUARY TO DECEMBER 2016

MONTHS	INTERRUPTIONS	Outage(HOURS)	TOTAL HOURS	TOTAL CUSTOMERS	SAIFI	SAIDI	CAIDI	ASAI	ASUI
Jan	85	252.17	744	2170	85.00	252.17	2.97	0.6611	0.3389
Feb	86	270.55	672	2170	86.00	270.55	3.15	0.5974	0.4026
Mar	114	290.88	744	2170	114.00	290.88	2.55	0.6090	0.3910
Apr	98	277.97	720	2170	98.00	277.97	2.84	0.6139	0.3861
May	122	266.85	744	2170	122.00	266.85	2.19	0.6413	0.3587
Jun	138	224.22	720	2170	138.00	224.22	1.62	0.6886	0.3114
Jul	63	53.42	744	2170	63.00	53.42	0.85	0.9282	0.0718
Aug	49	70.87	744	2170	49.00	70.87	1.45	0.9047	0.0953
Sep	55	170.63	720	2170	55.00	170.63	3.10	0.7630	0.2370
Oct	79	182.4	744	2170	79.00	182.40	2.31	0.7548	0.2452
Nov	94	276.78	720	2170	94.00	276.78	2.94	0.6156	0.3844
Dec	121	289.53	744	2170	121.00	289.53	2.39	0.6108	0.3892
TOTAL	**1104**	**2626.27**	**8760**	**26040**	**1104.00**	**2626.27**	**2.36**	**0.699047**	**0.300953**

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor & UGC Approved Journal)

Website: www.ijareeie.com

Vol. 6, Issue 9, September 2017

TABLE 7. COMPUTED CUSTOMER ORIENTED ELIABILITY INDICES ON VASTARE FEEDEROF CHIKKAMAGALURU MUSS FROM JANUARY TO DECEMBER 2016

Vastare 11kV distribution Feeder from chikkamagaluru MUSS													
Load Data			**Line Data**				**Load Data**			**Line Data**			
Load point	**Real Data**	**Reactive data**	**BUS NO**	**Distance in kms**	**Resistance**	**Reactance**	**Load point**	**Real Data**	**Reactive data**	**BUS NO**	**Distance in kms**	**Resistance**	**Reactance**
1	16	11	1-2	1	0.545	0.421	59	41	29	57-58	1	0.545	0.421
2	41	29	2-3	0.5	0.272	0.211	60	16	11	59-60	0.25	0.136	0.105
3	16	11	3-4	0.5	0.272	0.211	61	16	11	58-61	2.3	1.253	0.968
4	16	11	4-5	0.5	0.272	0.211	62	16	11	61-62	0.5	0.272	0.211
5	16	11	5-6	0.75	0.409	0.316	63	16	11	62-63	1.5	0.817	0.632
6	41	29	6-7	2	1.09	0.842	64	16	11	63-64	2.5	1.362	1.053
7	41	29	7-8	7	3.814	2.947	65	16	11	58-88	1.5	0.817	0.632
8	64	46	8-9	2.5	1.362	1.053	66	16	11	88-69	4.5	2.452	1.895
9	64	46	9-10	2	1.09	0.842	67	16	11	69-70	3	1.635	1.263
10	16	11	10-11	0.25	0.136	0.105	68	16	11	70-68	1	0.545	0.421
11	41	29	11-12	0.5	0.272	0.211	69	16	11	68-67	2	1.09	0.842
12	16	11	8-13	2.5	1.362	1.053	70	16	11	67-65	0.7	0.381	0.295
13	16	11	13-14	0.5	0.272	0.211	71	16	11	65-66	0.9	0.49	0.379
14	41	29	14-15	0.5	0.272	0.211	72	16	11	70-71	1	0.545	0.421
15	16	11	15-16	0.5	0.272	0.211	73	16	11	71-71	0.5	0.272	0.211
16	16	11	16-17	0.5	0.272	0.211	74	16	11	72-73	0.5	0.272	0.211
17	41	29	17-18	2.25	1.226	0.947	75	16	11	73-75	1.5	0.817	0.632
18	16	11	18-19	0.5	0.272	0.211	76	16	11	75-74	0.25	0.136	0.105
19	16	11	19-20	0.4	0.218	0.168	77	16	11	75-76	1.5	0.817	0.632
20	16	11	18-21	0.25	0.136	0.105	78	16	11	76-77	1	0.545	0.421
21	41	29	21-	2	1.09	0.84	79	16	11	77-78	1.5	0.817	0.632

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor & UGC Approved Journal)

Website: www.ijareeie.com

Vol. 6, Issue 9, September 2017

			22			2							
22	41	29	6-23	1	0.545	0.421	80	41	29	78-80	1	0.545	0.421
23	16	11	23-24	0.75	0.409	0.316	81	16	11	80-79	0.25	0.136	0.105
24	64	46	24-25	0.4	0.218	0.168	82	16	11	80-81	0.5	0.272	0.211
25	16	11	25-27	1.55	0.845	0.653	83	16	11	81-82	0.25	0.136	0.105
26	41	29	26-27	1.35	0.736	0.568	84	41	29	82-83	1	0.545	0.421
27	41	29	25-28	1.6	0.872	0.674	85	41	29	83-84	1	0.545	0.421
28	41	29	28-29	2	1.09	0.842	86	16	11	84-85	2	1.09	0.842
29	16	11	29-30	2	1.09	0.842	87	16	11	85-86	1	0.545	0.421
30	16	11	30-31	0.5	0.272	0.211	88	16	11	86-87	1	0.545	0.421
31	16	11	29-32	0.5	0.272	0.211	89	16	11	88-89	3.75	2.043	1.579
32	16	11	32-33	0.5	0.272	0.211	90	16	11	89-90	1	0.545	0.421
33	16	11	33-34	0.25	0.136	0.105	91	16	11	90-91	0.75	0.409	0.316
34	16	11	6-35	2.25	1.226	0.947	92	41	29	91-92	0.25	0.136	0.105
35	16	11	35-36	1	0.545	0.421	93	16	11	92-93	1	0.545	0.421
36	16	11	36-37	4.5	2.452	1.895	94	16	11	88-94	4	2.18	1.684
37	16	11	37-38	0.75	0.409	0.316	95	41	29	94-95	3	1.635	1.263
38	41	29	38-39	3.5	1.907	1.474	96	16	11	95-96	0.5	0.272	0.211
39	16	11	39-40	7.5	4.087	3.158	97	16	11	96-97	0.5	0.272	0.211
40	16	11	40-41	2.5	1.362	1.053	98	41	29	97-98	0.5	0.272	0.211
41	16	11	41-42	1	0.545	0.421	99	16	11	94-99	2.6	1.417	1.095
42	41	29	42-43	1.5	0.817	0.632	100	16	11	99-100	0.2	0.109	0.084
43	41	29	43-44	0.5	0.272	0.211	101	16	11	100-103	0.5	0.272	0.211
44	16	11	44-45	6.5	3.542	2.737	102	16	11	103-101	0.5	0.272	0.211
45	41	29	45-46	4	2.18	1.684	103	16	11	101-102	0.75	0.409	0.316

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

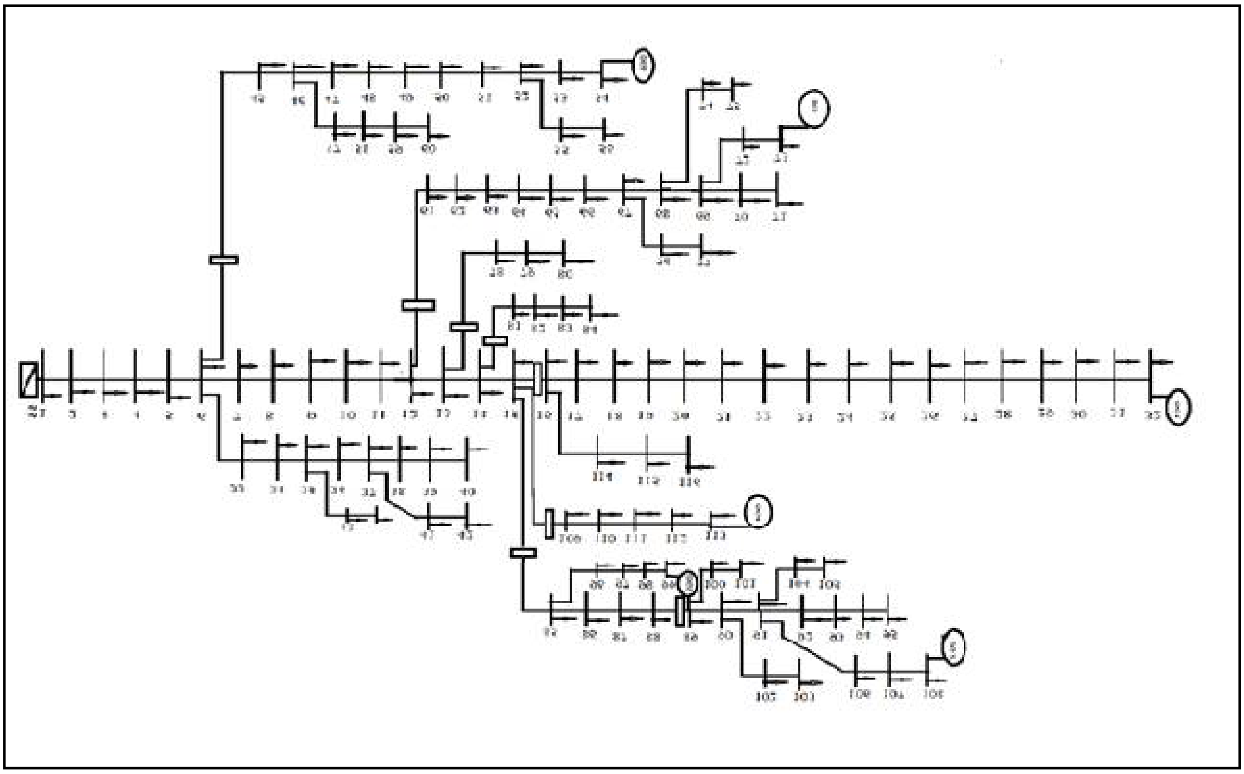
International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor & UGC Approved Journal)

Website: www.ijareeie.com

Vol. 6, Issue 9, September 2017

46	16	11	46-47	0.75	0.409	0.316	104	16	11	103-104	1.1	0.599	0.463
47	16	11	47-48	2	1.09	0.842	105	16	11	104-107	2	1.09	0.842
48	16	11	46-49	1.45	0.79	0.61	106	16	11	107-106	0.25	0.136	0.105
49	16	11	49-50	1.5	0.817	0.632	107	41	29	104-105	1.5	0.817	0.632
50	16	11	49-51	1	0.545	0.421	108	41	29	105-109	6.5	3.542	2.737
51	41	29	51-52	0.75	0.409	0.316	109	41	29	109-108	0.1	0.054	0.042
52	16	11	50-53	3.5	1.907	1.474	110	16	11	105-110	4.1	2.234	1.726
53	41	29	53-54	2.25	1.226	0.947	111	41	29	110-113	2.4	1.308	1.01
54	16	11	50-55	1.25	0.681	0.526	112	41	29	113-111	3	1.635	1.263
55	16	11	55-56	1	0.545	0.421	113	16	11	111-112	2	1.09	0.842
56	16	11	39-57	6	3.269	2.526	114	41	29	110-114	2.5	1.362	1.053
57	16	11	57-59	0.5	0.272	0.211	115	41	29	114-115	2	1.09	0.842
58	16	11	57-58	0.5	0.272	0.211	116	41	29	115-116	2	1.09	0.842



Copyright to IJAREEIE

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor & UGC Approved Journal)

Website: www.ijareeie.com

Vol. 6, Issue 9, September 2017

The load flow analysis done using simulation software MATLAB for the practical load data and line data of vastare feeder and the results are tabulated in the Table 8.

Without DG Units	
Active Power loss(kW)	915.5021
Reactive Power loss(kVAr)	707.3342
Bus with highest LSF	32
Optimal DG Size(kW)	569.597

TABLE 9. LOADFLOW ANALYSIS OF VASTARE FEEDER

The above table shows the bus with highest LSF i.e., Bus number 32 and size of the distribution generator suggested by the MATLAB program is 600kW. The single line diagram of Vastare feeder as shown in fig.1 above.

By the above analysis the Distribution Generator is placed in the bus number 32 of capacity 600kW. The customers are fed from this distribution generator when main supply from chikkamagaluru MUSS fails or any fault occurs in the distribution line, the supply will be fed from this distribution Generator 1. The numbers of customers affected are now reduced as the DG1 operates. The reliability indices are calculated after placing the DG1 and summarised in the table 9.

SAIDI	**SAIFI**	**CAIDI**	**ASAI**	**ASUI**
2179.68	916.27	2.36	0.750223	0.249777

TABLE 10. COMPUTED CUSTOMER ORIENTED INDICES AFTER PLACEMENT of DG1

The DG optimization results are summarised in Table 10.

DG Size(kW)	600
Location(Bus Number)	32
Active Power loss(kW)	497.0076
Reactive Power loss(kVAr)	383.9974
Bus with highest LSF	108
Optimal DG Size(kW)	465.0386

TABLE 11. LOADFLOW ANALYSIS OF VASTARE FEEDER WITH ONE DISTRIBUTED GENERATOR

The DG2 of capacity 500kW is placed at the bus number 108 along with DG1 and again load flow analysis done. Now by operating two DGs still the numbers of customers affected are reduced. The reliability indices calculated after placing two DGs and results are tabulated in Table 11.

SAIDI	**SAIFI**	**CAIDI**	**ASAI**	**ASUI**
1854.12	779.41	2.36	0.78753	0.21247

TABLE 12. COMPUTED CUSTOMER ORIENTED INDICES AFTER PLACEMENT of DG2

The DG optimisation result for two DG placement is tabulated in Table 12.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor & UGC Approved Journal)

Website: www.ijareeie.com

Vol. 6, Issue 9, September 2017

DG Size(kW)	600, 500
Location(Bus Number)	32, 108
Active Power loss(kW)	315.6347
Reactive Power loss(kVAr)	243.8653
Bus with highest LSF	73
Optimal DG Size(kW)	465.0386

TABLE 13. LOADFLOW ANALYSIS OF VASTARE FEEDER WITH TWO DISTRIBUTED GENERATOR

The results from the above tables show improvement in reliability after placement of DG2. Similarly the load flow analysis done with 3DGs, 4DGs, 5DGs and 6DGs.The reliability indices calculated after placing 6 DGs are tabulated in Table 14.

SAIDI	**SAIFI**	**CAIDI**	**ASAI**	**ASUI**
790.3015	332.2175	2.36	0.909437	0.090563

TABLE 14. COMPUTED CUSTOMER ORIENTED INDICES AFTER PLACEMENT of DG1-DG6

The DG optimisation result for six DG placement is tabulated in Table 15

DG Size(kW)	600, 500,300,200,200,200
Location (Bus Number)	32, 108,73,113,99,54
Active Power loss(kW)	198.2935
Reactive Power loss(kVAr)	153.2053
Bus with highest LSF	80
Optimal DG Size(kW)	140.9407

TABLE 15. LOADFLOW ANALYSIS OF VASTARE FEEDER WITH SIX DISTRIBUTED GENERATOR

The results tabulated above shows the improvement in reliability and active power loss is also reduced. Hence the above analysis shows that optimal placing, sizing and number of DG can improve the reliability.

IV. CONCLUSION

The reliability indices for the existing vastare feeder without DG are SAIDI is 2626.27, SAIFI is 1104 ,CAIDI is 2.36, ASAI is 0.699047 and ASUI is 0.300953. The active power loss and reactive power loss are 915.5021kW and 707.3342kVAR respectively. The power outage is due to scheduled and forced outage. The power outage causes inconvenience to consumers and loss in terms of revenue to electric utilities. The reliability of the existing vastare feeder is improved after optimal placing of 6 DGs. The reliability indices SAIDI is improved from 2626.27 to 790.30, SAIFI is improved from 1104 to 332.21 and the availability of the feeder is increased from 0.699046726 to 0.909437. The inserting of DGs to existing network will also improve voltage profile. Due to increasing load demand utilities have to invest more money to construct new lines and supporting structures. By using DG technology this cost can be avoided as the DGs are installed near to the load centre. Also DGs are more of less pollutant to zero pollutant and contribute to green environment. The cost of installation of DGs will payback after certain years and this will improve the revenue of the electric utilities and can serve better the consumers.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor & UGC Approved Journal)

Website: www.ijareeie.com

Vol. 6, Issue 9, September 2017

ACKNOWLEDGEMENT

The author thanks the staff of chikkamagaluru MUSS who assisted in obtaining all the data discussed above.

REFERENCES

[1] Billinton, Roy, Reliability assessment of large electric power systems
[2] Power system dynamics – stability and control, K R PADIYAR
[3] Electric Power Generation, Transmission and Distribution, S N Singh.
[4] Electric Power Distribution System Engineering, Turan Gonen 2008
[5] B. Roy and R. N. Allan, Reliability Evaluation of Power Systems, 2 nd Ed. Springer, New Delhi, 2008, pp 220-221
[6] A. S. Pabla, Electric Power Distribution, 5th Ed., New Delhi, India: Tata Mc Graw–Hill Publishing Company Limited, 2008
[7] K. Kolowrocki, "Limit reliability functions of some series-parallel and parallel series systems," Journal of Applied Mathematics and Computation, vol. 62, pp. 129-151, 1994