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Feeder Renovation in Electric Power System for Reduction of Transmission and Distribution Losses

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Abstract
Feeder renovation is a technique basically of high transmission and high distribution system as opposed to present high transmission but low distribution scheme. It aims at reducing the amount of loading at individual transformers and eventually leading to increase in number of transformers. High distribution cable voltage would be stepped down and from there supply would be given to end consumers. The basic idea is to reduce unpaid loads. The constraints associated are very high installation cost and complete over hauling of existing power supply system. It is a time taking idea and requires proper monitoring. Also the time period of recovery is about 3-4 years. Stability of power supply can be an important parameter to judge a country's economic condition.

Keywords
Feeder renovation, Distribution, Transmission, T & D losses, Powerworld Simulator

I. Introduction

Feeder renovation consists of the modification of the topology of an electrical system. The Indian energy sector is today at a crucial juncture of development. With growing economy, the aspiration of people for improved energy services in terms of availability, accessibility, quality and affordable power have come up in a big way. However, the present energy scenario is not satisfactory as the demand and supply represents a deficit overall as well as across the states.[1] The power sector reforms were initiated in the early 1990s with a need to accelerate the power generation. However, still there remains a wide scope for further reforms in several directions. Study found that states with higher power tariffs like Delhi, Punjab and Haryana have exhibited low power deficits while the states with lower power tariffs have high deficit such as J&K and UP. India is currently facing power deficit of 8.5%.[2] In the state of Rajasthan distribution system was suffering badly from very high distribution losses as well as poor quality of supply and electrical network which needed to be improved by making proper capital investment on a techno-economic consideration to finally affect a turnaround of the Distribution company and quality services to the consumers. In 1993, the Government of Rajasthan (GoR) decided to reform its power sector. This was followed by a Broad Reform Policy Statement, issued in Sept [3]. 1995. The policy statement was further revised in 1997 and 1998 and finally adopted in May 1999. Rajasthan Electricity Regulatory Commission (RERC) established on 2nd January, 2000 under the ERC Act, 1998.The main theme of FRP was to segregate electrical network for three phase agriculture load and single phase D.S. NDS etc. load besides so many other interventions.[6]

II. Method

In FR we segregation of domestic and agriculture supply system. To reduce accident risks associated with snapping of conductor in rural areas. In this simulation we use Newton raphson method and compare Existing and Proposed system

. $x_{n+1} = x_n - f(x_n)/Q(x_{n-1}; x_n)$

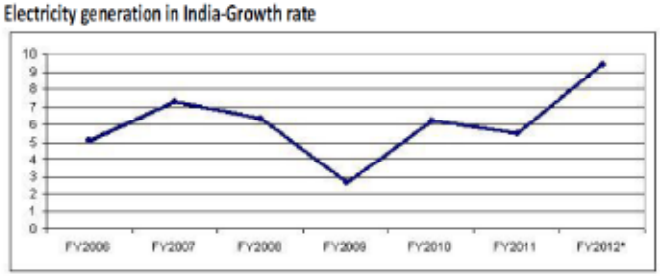
; where $Q(x_{n-1}; x_n) = f(x_{n-1}) - f(x_n)/x_{n-1} - x_n$

Table 1:

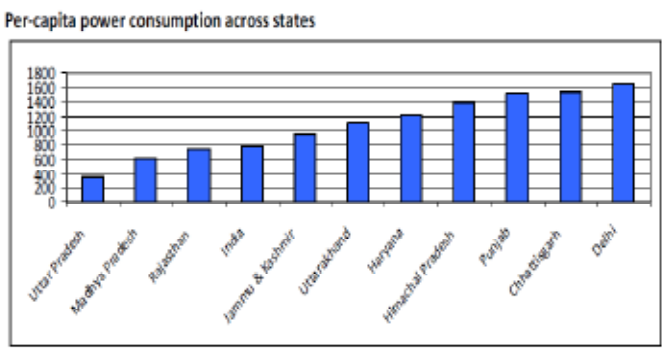
Trend in Industrial investment

S. no.	States	GSDP as a % of India's GSDP(FY2009)	Industrial investments proposals as a % of total investment during			% Energy Surplus(+)/deficit(-)
			2009	2010	2011(upto June)	
1	UP	8.92	0.97	0.79	1.39	-15
2	Rajasthan	4.76	1.29	1.71	0.57	-0.9
3	Delhi	4.04	0.03	0.01	0.003	-0.3
4	Haryana	3.67	0.23	0.60	0.53	-5.6
5	MP	3.63	6.41	11.77	7.86	-20.2
6	Punjab	3.42	0.94	0.39	0.82	-6
7	Chhattisgarh	1.77	12.56	16.45	4.32	-1.7
8	Uttarakhand	0.91	0.89	0.46	0.32	-6
9	HP	0.88	0.58	0.21	0.10	-3.4
10	J&K	0.81	0.12	0.07	0.11	-25

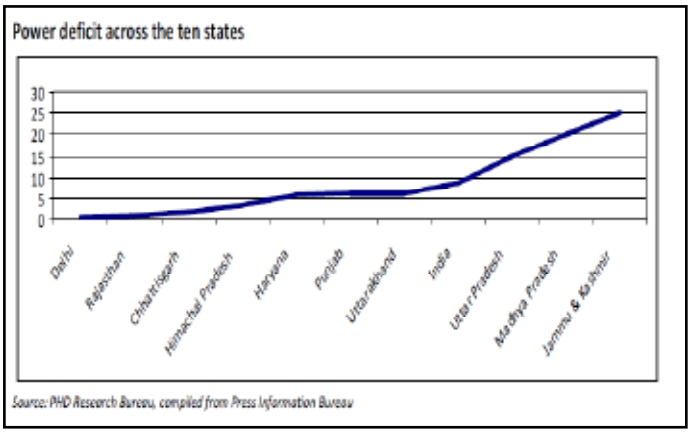
Source: PhD Research Bureau, compiled from various sources



Source: PhD Research Bureau, compiled from Office of the Economic Advisor.
* April to July 2011-12



Source: PhD Research Bureau, compiled from Press Information Bureau
Data pertains to FY2010



1. To develop single phase H.T. system for D.S. & NDS consumers of rural areas by extending one phase of HT system and neutral wire from the existing three phase 11 kV H.T. system.
2. Installation of low rating, low loss copper wound single phase distribution transformers on this extended one phase H.T. system.
3. Providing of 25 kVA distribution transformers with a M&P box attached to its body, having provision for installation of two meters, MCBs and capacitor in the M&P box. The LT bushings of these transformers are completely concealed thus maximum two consumers on each transformer.
2. Laying of separate 3 Phase AB cable for each AG consumer from distribution transformers with a maximum length of 270 meters.
3. Replacement of bare conductor LT over head lines by AB cables and insulated rabbit conductor.
4. Laying of single phase AB cable from single phase distribution transformers for providing supply to Domestic and non domestic consumers of rural area
5. Replacement of existing obsolete service line of consumer by armoured XLPE cable
6. Installation of push fit type static meters by replacing the existing slow and sluggish old type meters. To keep the serial number of seals of meter box, meter body, meter terminal plate same as that of meter number use of double anchor special seals for meter box
7. Installation of roaster switch on 132 kV substation and 33/11 kV S/S for every 11 kV rural feeder emanating from GSS and substation.
8. Installation of metering equipment at the emanating point of all feeders for feeder metering to calculate T&D losses of feeders.

Table. 2:

The Energy so far.....

Contents	Units
Installed Capacity	176 GW
Private sector share in generation	22%
Share of RE capacity	10.42
Gross generation	811 bn KWh
PLF(Central sector)	85%
PLF(State sector)	71%
Peak deficit	9.8%
Energy Deficit	8.5%
Per-capita energy consumption(FY2010)	779KWh
Villages Electrified	91%
Households Electrified	56%
Transmission & Distribution loss (FY2009)	25.4%

Source: PHD Research Bureau, compiled from various sources.

III. EXISTING AND PROPOSED MODELS WITH COMPARISON

1. Existing model

Existing model has interruptable power supply with around 40% T&D losses. Also the rate of transformer failure is high. The POWERWORLD simulator circuit for existing system is attached in the following pages.

2. Proposed model

Proposed model aims at reducing T&D losses to a maximum of 15% initially. It would lead to regulated power supply. Also the rate of transformer failure would be effectively reduced. Eventually all this would lead to a drastic reduction in fiscal deficit.

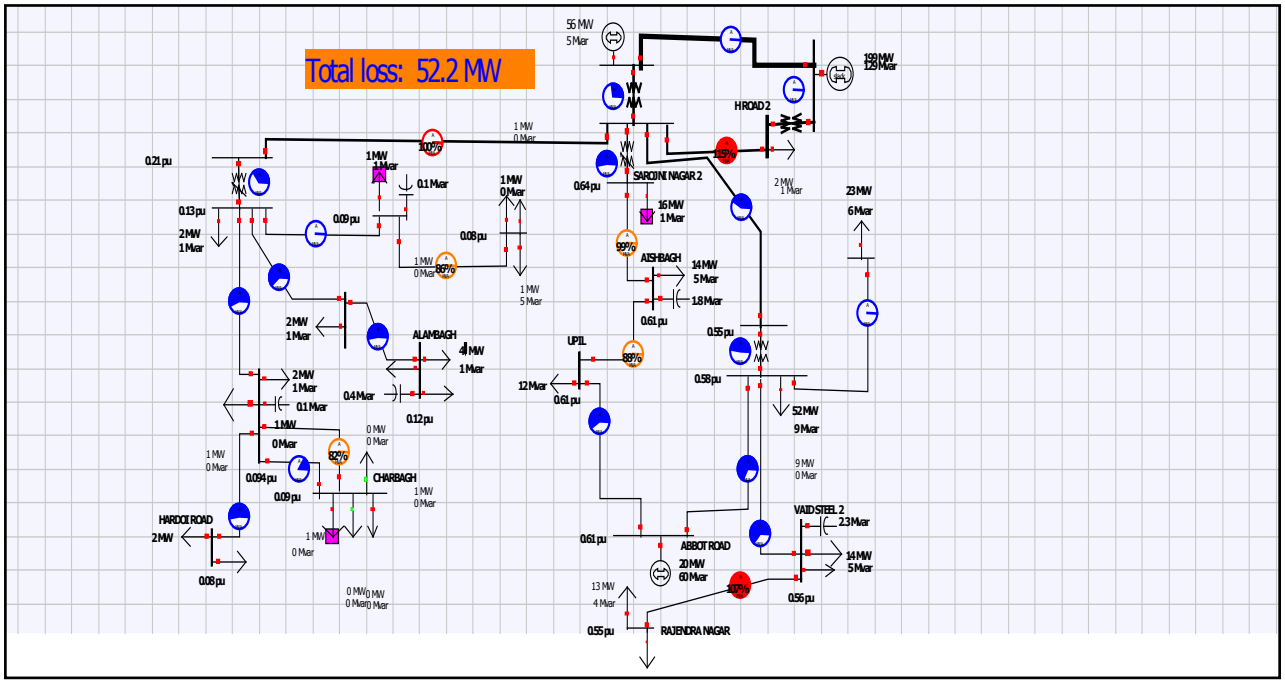


Fig. 1: Simulation of Existing System

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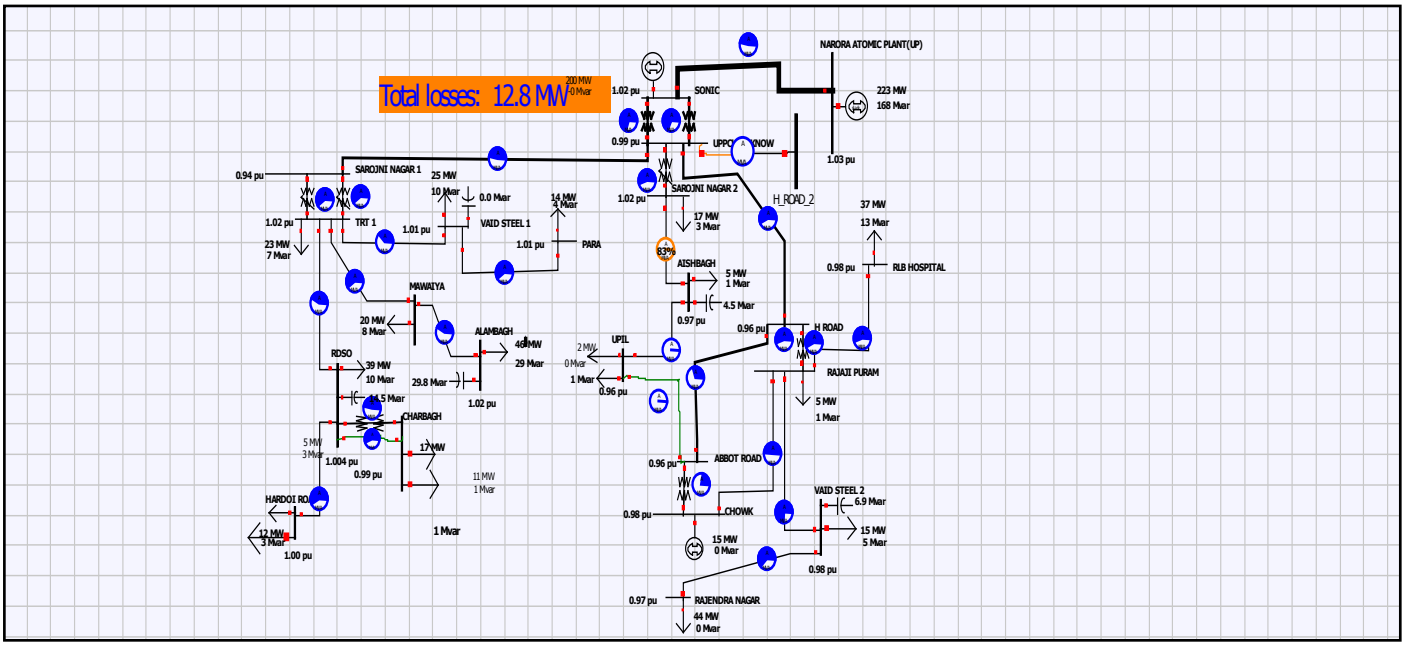

Fig. 2: Simulation of Proposed System

Results: COMPARISON BETWEEN EXISTING AND PROPOSED MODEL

Table. 3: Results From Existing System

	From Number	From Name	To Number	To Name	Cir.	Status	Xfmr	MW From	Mvar From	MVA From	Lim MVA	% of MVA Limit (Max)	MW Loss	Mvar Loss
1	20	VAID STEEL	21	RAJENDRA	1	Closed	NO	44.5	0.4	44.5	72.0	61.9	0.19	0.41
2	18	UPTL	22	ABBOT ROA	1	Closed	NO	53.3	26.0	59.3	80.0	74.1	0.01	0.38
3	1	NARORA A	2	SONIC	1	Closed	NO	222.7	168.4	279.2	600.0	46.8	0.35	-2.55
4	23	CHOWK	22	ABBOT ROA	1	Closed	YES	-12.5	43.2	45.0	187.0	24.0	0.03	1.09
5	3	UPPCL LUCI	6	H ROAD	1	Closed	NO	108.8	20.7	110.8	200.0	55.4	2.11	11.11
6	3	UPPCL LUCI	7	H_ROAD_2	1	Closed	YES	0.0	-0.0	0.0	100.0	0.0	0.00	0.00
7	8	TRT 1	4	SAROJNI N	1	Closed	YES	-106.7	-17.6	108.2	187.0	58.8	0.20	8.06
8	3	UPPCL LUCI	4	SAROJNI N	1	Closed	NO	217.9	77.3	231.2	500.0	46.2	3.93	26.03
9	3	UPPCL LUCI	2	SONIC	1	Closed	YES	-210.9	-68.8	221.9	334.0	68.3	0.29	16.68
10	10	RAJAJI PUF	6	H ROAD	1	Closed	YES	-87.7	-60.0	106.3	187.0	57.5	0.05	2.12
11	6	H ROAD	22	ABBOT ROA	1	Closed	NO	18.9	-52.5	55.8	185.0	30.2	0.05	-12.59
12	8	TRT 1	11	RDSO	1	Closed	NO	84.8	10.2	85.4	200.0	42.7	1.07	3.38
13	8	TRT 1	12	MAWAIYA	1	Closed	NO	65.9	4.9	66.1	112.0	59.0	0.19	-1.25
14	8	TRT 1	13	VAID STEEL	1	Closed	NO	39.8	13.6	42.1	112.0	37.6	0.16	0.43
15	9	AISHBAGH	18	UPTL	1	Closed	NO	70.6	28.0	75.9	100.0	75.9	0.25	1.00
16	19	RLB HOSPIT	10	RAJAJI PUR	1	Closed	NO	-37.2	-13.4	39.5	72.0	55.1	0.15	-0.02
17	20	VAID STEEL	10	RAJAJI PUR	1	Closed	NO	-59.8	1.5	59.9	82.0	73.6	0.50	1.16
18	10	RAJAJI PUF	23	CHOWK	1	Closed	NO	-14.9	46.0	48.3	100.0	51.0	0.16	-2.73
19	5	SAROJNI N	3	UPPCL LUCI	1	Closed	YES	-94.6	-32.2	100.0	186.7	55.0	0.18	7.20
20	5	SAROJNI N	9	AISHBAGH	1	Closed	NO	77.8	29.7	83.3	100.0	83.3	2.27	5.18
21	17	HARDOI RC	11	RDSO	1	Closed	NO	-16.6	-3.2	16.9	30.0	56.6	0.09	0.07
22	15	ALAMBAGH	12	MAWAIYA	1	Closed	NO	-46.2	0.6	46.2	112.0	41.3	0.02	-1.11
23	13	VAID STEEL	14	PARA	1	Closed	NO	14.4	3.6	14.8	25.0	59.2	0.03	-0.06
24	3	UPPCL LUCI	2	SONIC	2	Closed	YES	-210.6	-68.6	221.5	325.0	70.0	0.29	16.64
25	11	RDSO	16	CHARBAGH	2	Closed	YES	12.1	-44.7	46.3	101.0	46.4	0.02	0.66
26	8	TRT 1	4	SAROJNI N	2	Closed	YES	-106.7	-17.6	108.2	187.0	58.8	0.20	8.06
27	11	RDSO	16	CHARBAGH	3	Closed	NO	15.9	53.1	55.4	101.0	54.9	0.02	0.83

Table. 4: Results From Existing System

	From Number	From Name	To Number	To Name	Circuit	Status	Xfmr	MW From	Mvar From	MVA From	Lim MVA	% of MVA Limit (Max)	MW Loss	Mvar Loss
1	7	H ROAD 2	1	NARORA ATOMI	1	Closed	YES	-170.8	-234.3	290.0	220.0	152.6	0.92	54.19
2	7	H ROAD 2	3	UPPCL LUCKNOV	1	Closed	NO	168.8	233.8	288.4	250.0	115.3	16.88	117.55
3	5	SAROJINI NAGAI	9	AISHBAGH	1	Closed	NO	86.4	4.6	86.5	82.0	105.5	4.02	9.38
4	20	VAID STEEL 2	21	RAJENDRA NAG	1	Closed	NO	27.3	6.7	28.1	27.0	104.1	0.24	0.57
5	3	UPPCL LUCKNOV	4	SAROJINI NAGAI	1	Closed	NO	40.4	146.0	151.5	155.0	97.7	14.50	100.24
6	9	AISHBAGH	18	UPTL	1	Closed	NO	68.2	-7.8	68.6	72.0	95.3	0.55	2.23
7	1	NARORA ATOMI	2	SONIC	1	Closed	NO	27.1	-155.0	157.4	197.0	86.1	1.76	-322.82
8	13	VAID STEEL 1	14	PARA	1	Closed	NO	5.3	6.6	8.4	10.0	84.1	0.95	1.27
9	11	RDSO	16	CHARBAGH	2	Closed	NO	0.7	0.3	0.8	1.0	79.4	0.00	-0.01
10	19	RLB HOSPITAL	10	RAJAJI PURAM	2	Closed	NO	-22.6	-6.3	23.4	30.0	78.7	0.12	0.19
11	8	TRT 1	13	VAID STEEL 1	1	Closed	NO	7.7	10.2	12.8	17.0	75.2	1.01	3.22
12	10	RAJAJI PURAM	22	ABBOT ROAD	1	Closed	NO	-43.8	-36.2	56.8	83.0	70.5	1.36	1.01
13	22	ABBOT ROAD	18	UPTL	1	Closed	NO	-25.3	22.8	34.0	50.0	68.0	0.82	1.08
14	20	VAID STEEL 2	10	RAJAJI PURAM	1	Closed	NO	-49.7	-9.0	50.5	82.0	63.6	1.14	2.76
15	17	HARDOI ROAD	11	RDSO	1	Closed	NO	-2.5	-0.3	2.5	5.0	60.3	0.33	0.81
16	8	TRT 1	12	MAWAIYA	1	Closed	NO	6.9	1.7	7.1	12.0	59.1	0.15	0.74
17	5	SAROJINI NAGAI	3	UPPCL LUCKNOV	1	Closed	YES	-102.7	-5.5	102.9	186.7	57.0	0.54	20.37
18	8	TRT 1	11	RDSO	1	Closed	NO	8.9	6.1	10.8	20.0	54.0	1.17	3.80
19	15	ALAMBAGH	12	MAWAIYA	1	Closed	NO	-5.0	-0.4	5.0	10.0	50.2	0.02	0.04
20	3	UPPCL LUCKNOV	2	SONIC	2	Closed	YES	-76.2	-80.1	110.6	400.0	48.1	1.71	95.76
21	10	RAJAJI PURAM	6	H ROAD 1	1	Closed	YES	-80.4	8.9	80.9	187.0	43.3	0.22	8.88
22	3	UPPCL LUCKNOV	6	H ROAD 1	1	Closed	NO	84.4	24.5	87.9	233.0	37.7	3.79	24.58
23	8	TRT 1	4	SAROJINI NAGAI	2	Closed	YES	-25.2	-18.6	31.3	300.0	17.5	0.72	27.18
24	11	RDSO	16	CHARBAGH	1	Closed	NO	0.7	0.3	0.8	5.0	15.9	0.00	-0.01

IV. Conclusion

The Indian energy sector is today at a crucial juncture of development. With growing economy, the aspiration of people for improved energy services in terms of availability, accessibility, quality and affordable power have come up in a big way. However, the present energy scenario is not satisfactory as the demand and supply represents a deficit overall as well as across the states.

THE PROJECT intends to bridge the gap between losses in INDIA and FOREIGN COUNTRIES. Transmission and distribution losses if reduced to 8-9% as outside would be a boon for the country. A lot more houses can be lightened. More power coverage would lead to modernization of the economy as well.

But as every coin has both the aspects, same is the case here as well. It's a time taking process and requires a lot of initial fund investment to be implemented. INDIA at present can't afford it. Also corruption nexus acts as a major deterrent. So these have to be taken care of while implementation. Contrarily If done properly, it can prove a silver lining in the cloud!

V. Acknowledgement

In the sense of great pleasure and satisfaction we present this project entitled "Feeder Renovation in Electric Power System for Reduction of Transmission and Distribution Losses". The completion of this project is no doubt a product of invaluable support and contribution of number of people. I would like to express our sincere thanks to our guide Mrs. Bharti Dwivedi (Professor, Department of Electrical and Electronics Engineering.) for his continuous help and valuable suggestions and also providing encouraging environment, without which our project and its documentation would not have been possible.

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