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Computation of Sensitive Node Subjected To Continuous Power Flow (CPF) With Regression

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Abstract

Load flow examination is a significant technique to the power system investigation and planning. Here investigation is done at every single condition of arranging, activity, control and future economics. Included, it has to focus around the acquisition for most sensitive node in IEEE-37 power system. simulations are done at PSAT Matlab Toolbox which incorporates a total arrangement of easy to use graphical interface and a Simulink-based editorial manager for one-line organize outlines which uses the L-list strategy and VCPI for voltage strength examination and sensitive nodes persistence. Here, firstly it procures to investigate IEEE- 37 bus network beneath typical test data and after using the data linear regression process has been studied. For finding a most sensitive node and connecting the compensator for the lowest bus, simulation results are correlated along the authentic power flow simulations results of IEEE- 37 bus system.

I. INTRODUCTION

Voltage stability is there capacity of a power system to keep up consistent state voltage at all buses in the framework at typical qualities and in the wake of being exposed to an unsettling influence [1]. The power systems get precarious, while voltages wildly adjustments because of this harmony among burden and age, blackout of gear and lines and disappointment of voltage control instrument in the framework. The issue of voltage insecurity happens predominantly because of insufficient supply of the responsive power or a pointless assimilation of receptive power. Persistent checking by the power system status is compulsory in light of the fact that the voltage precariousness influences the good activity of intensity power system [2]. The moderate variety in responsive load of power approaching its most extreme point causes the ordinary load stream answer for achieve its non-combination point. The conventional load stream arrangement doesn't unite, past this point for example it powers the system to arrive at the voltage solidness limit before bifurcation in the framework [3]. The edge determined from effecting common case results for the most extreme assembly point into the load flow computation decides the load ability greatest at the specific bus into the power system. Subsequently in these systems inspected IEEE-37 power system.

II. VOLTAGE STABILTY

According to the Indian conventional electrical foundation was commonly viewed as problematic. Here the fundamental to find a delicate hub in the force framework so as to evade the serious unsettling influences. The basic transport is dictated by discovering the greatest adequate load on effective bus.In the moistest influence bus into the power system is effective bus that can acknowledge littlest greatest influenced load. Line voltage stability record technique, Fast Voltage Stability Index (FVSI) and Voltage Collapse Prediction Index (VCPI) are some most significant strategies which are accustomed to discovering the touchiest line in effective power system.

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LINE INDEX FORMULATION

Line stability index (LSI) and FVSI record definition is talked about here in these subsections as follows:

Line Stability Index (LSI)

In view of effective transmission idea in a solitary line M. Moghavvemi's determined a line steadiness record to discover the voltage by an together connected power system in a decreased single line organize [4]. Here the plan discriminator by the voltage quadratic condition endures set into the more prominent or equivalent than zero to look after voltage stability. A normal lowly transmission line situation record is gotten from its outlined in Fig. 1

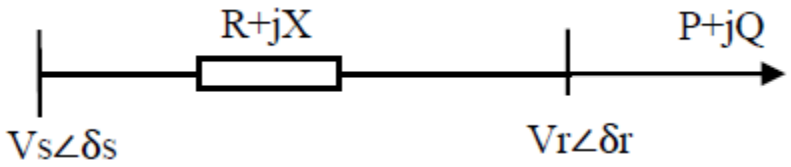

Fig. 1. Line diagram of the transmission line.

At the point when the solidness file L_{mn} is under 1, in this power system is steady and when that file surpasses the worth 1, effective power system loses its steadiness and voltage breakdown happens. Subsequently the estimation of L_{mn} should be less than 1 to keep up stable power systems.

III. CALCULATING THE MOST CRITICAL BUS VOLTAGE

In this process first Reactive power at the load bus is slowly increasing and keeps all the reaming loads are kept constant. After that Load flow simulations are perform using PSAT to finding the active & reactive generated in the receiving end by the specified load. Fallows maximize Active and reactive power that is to be transfer into a specified bus is determine by using effective given bus. And next LSI and VCPI is determine on every load bus known power transfer into using by load flows. Next repeat the same at each and every load bus and line indices are determine by each and every line correlated with load bus. Effective load have maximize the value of this line stability indices by maximum load ability section is in to effective most critical line with respect to that bus.

IV. SIMULATION RESULTS

PSAT is a Matlab tool to the electric engineering investigation along regulation. PSAT contains power flow and continuation power flow, optimal power flow, small signal stability investigation and it gives time domain results.All tasks can be assessed by the graphical UIs (GUI) and Simulation library gives an easy to understand instrument to arrange structure. PSAT includes the power stream schedule, which additionally deals with states variable instatement.

Once the power flow has been completed, further static and (/or) dynamic analysis can be executed [7]. These routines are:

When the power stream has been finished, further static and dynamic investigations are executed .

In this proposed solutions are done with IEEE- 37 load bus system. In this process using PSAT a Matlab Simulation tool used for Power System Analysis (PSA).

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V. RESLT ANALYSISS

Test System (IEEE 37-bus)

Buses:	37
Lines:	53
Generators:	15
Loads:	29

A. WITH OUT COMPENSATION

Our test system is a IEEE 37-bus system table 1 shows. Stimulated diagram of System with 37 buses. This system has 15 generation units that bus 1 is slack bus. Also it has 53 transmission lines, 2transformers and 29 load buses. Line Voltage index profiles at intervals different lines in the system are determining using LSI, VCPI methods. Effective defined data of voltage index profile endures in figure and table 1 gives the result data sheet of continues power flow, bus no 5 shows the sensitive bus among the 37 bus system. Here regression analysis also studied using matlab program it is also giving the 5^{th} bus is most sensitive is shown in figure 2 and pv curves shown in the figures

Table 1 load data IEEE 37 bus system

BETWEEN BUSES	LINE IMPDENCES		SUSCEPTANCE (PU)
	R (PU)	X(PU)	
1-2	0.000574	0.000293	0.02640
2-3	0.003070	0.001564	0.02190
3-4	0.002279	0.001161	0.01870
4-5	0.002373	0.001209	0.02460
5-6	0.005100	0.004402	0.01730
6-7	0.001166	0.003853	0.0064
7-8	0.004430	0.001464	0.0
8-9	0.006413	0.004608	0.0
9-10	0.006501	0.004608	0.0
10-11	0.001224	0.000405	0.0
11-12	0.002331	0.000771	0.0
12-13	0.009141	0.007192	0.0
13-14	0.003372	0.004439	0.0
14-15	0.003680	0.003275	0.0
15-16	0.004647	0.003394	0.0
16-17	0.008026	0.010716	0.0
17-18	0.004558	0.003574	0.0
2-19	0.001021	0.000974	0.0
19-20	0.009366	0.008440	0.0
20-21	0.002550	0.002979	0.0
21-22	0.004414	0.005836	0.0
3-23	0.002809	0.001920	0.0
23-24	0.005592	0.004415	0.0
24-25	0.005579	0.004366	0.0
6-26	0.001264	0.000644	0.0
26-27	0.001770	0.000901	0.0
27-28	0.006594	0.005814	0.0
28-29	0.005007	0.004362	0.0

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29-30	0.003160	0.001610	0.0
30-31	0.006067	0.005996	0.0
31-32	0.001933	0.002253	0.0
32-33	0.002123	0.003301	0.0
8-34	0.012453	0.012453	0.02652
9-35	0.012453	0.012453	0.01785
12-36	0.012453	0.012453	0.0087
18-37	0.003113	0.003113	0.02586
25-38	0.003113	0.003113	0.02356

Table 2 continues power flow results

24	POWER FLOW RESULTS						
25	Bus	V	phase	P gen	Q gen	P load	Q load
26		[p.u.]	[rad]	[p.u.]	[p.u.]	[p.u.]	[p.u.]
27	Bus1	1	0	22.7915	11.7984	0	0
28	Bus10	0.70991	-1.5614	1.7E-11	1.9E-12	0.97328	0.72996
29	Bus11	0.76718	-1.5326	4E-12	3E-12	0.97328	0.72996
30	Bus12	1	-1.451	1.94657	8.54157	0	0
31	Bus13	0.78234	-1.5328	-2E-13	3.2E-13	0.97328	0.72996
32	Bus14	0.80861	-1.5241	4.8E-13	3.3E-13	0.97328	0.72996
33	Bus15	0.93568	-1.6586	2.5E-12	2.7E-11	0.97328	0.72996
34	Bus16	0.69635	-1.1055	9.4E-11	6.1E-11	0.97328	0.72996
35	Bus17	0.79927	-1.4171	-2E-11	5.5E-11	0.97328	0.72996
36	Bus18	0.89244	-1.5677	-8E-12	7E-12	0.97328	0.72996
37	Bus19	1	-1.8078	-3E-13	2.6452	0.97328	0.72996
38	Bus2	1	-1.4134	1.94657	3.88936	0	0
39	Bus20	0.80547	-1.4254	-2E-12	1.9E-12	0.97328	0.72996
40	Bus21	0.84062	-1.4488	4.8E-12	4.1E-12	0.97328	0.72996
41	Bus22	1	-1.4987	3.1E-14	1.96644	0	0
42	Bus23	1	-1.3779	1.94657	2.73005	0	0
43	Bus24	1	-1.3873	7.5E-13	-0.0001	0	0
44	Bus25	0.85048	-1.4633	4.3E-12	4E-12	0.97328	0.72996
45	Bus26	1	-1.3966	-7E-12	6.48607	0.97328	0.72996
46	Bus27	0.78878	-1.3193	3.4E-12	1.4E-11	0.97328	0.72996
47	Bus28	0.83915	-1.4577	2.5E-12	2.2E-12	0.97328	0.72996
48	Bus29	1	-1.5048	1.94657	2.51221	0	0
49	Bus3	1	-0.9543	1.94657	6.88941	0	0
50	Bus30	1	-1.6065	7.2E-13	1.58281	0.97328	0.72996
51	Bus31	0.92952	-1.6018	2.3E-12	5.4E-12	0.97328	0.72996
52	Bus32	0.82252	-1.7198	2.7E-12	1.9E-12	0.97328	0.72996
53	Bus33	0.9035	-2.0982	4.7E-12	4.8E-12	0.97328	0.72996
54	Bus34	1	-1.9984	-8E-13	3.40019	0.97328	0.72996
55	Bus35	0.96633	-2.0997	2.6E-12	8.6E-12	0.97328	0.72996
56	Bus36	1	-2.0018	1.94657	1.01509	0.97328	0.72996
57	Bus37	1	-2.2057	2.2E-12	1.21766	0.97328	0.72996
58	Bus4	0.97106	-1.5227	1.7E-12	2E-12	0.97328	0.72996
59	Bus5	0.69278	-0.9274	3.5E-12	9.9E-12	0.97328	0.72996
60	Bus6	1	-1.5001	0.97328	3.78906	0.97328	0.72996
61	Bus7	0.83703	-1.4032	8.9E-12	1.7E-12	0.97328	0.72996
62	Bus8	1	-1.4706	1.94657	2.5631	0	0
63	Bus9	0.76645	-1.521	-5E-12	1.6E-11	0.97328	0.72996

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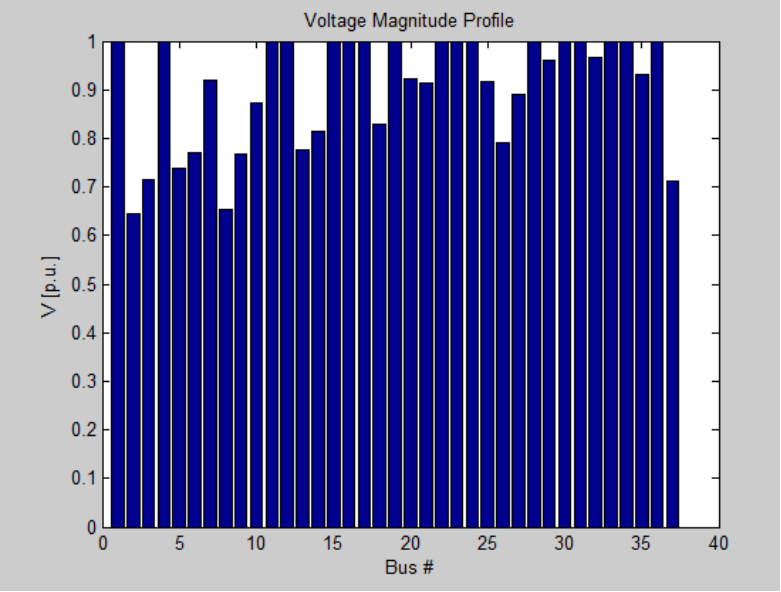

Fig.2 voltage profile 37 bus system

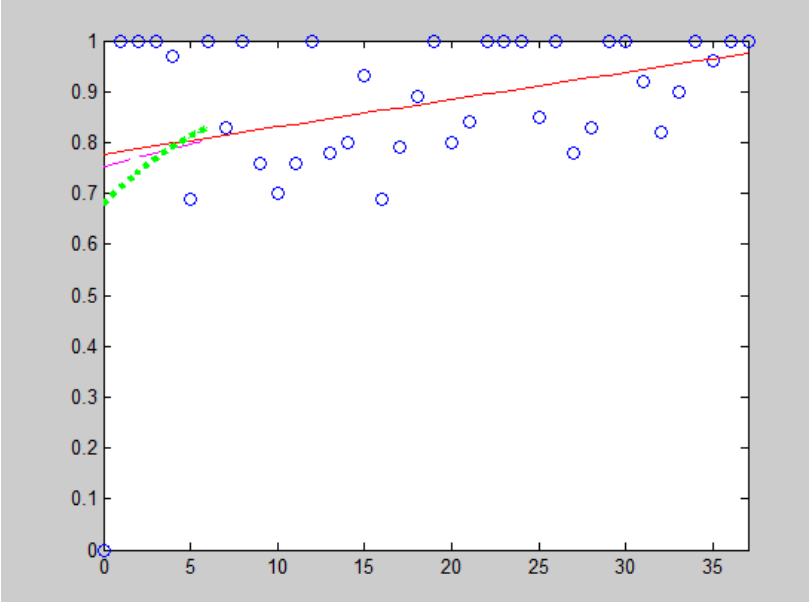

Fig.3 voltage profile with regression

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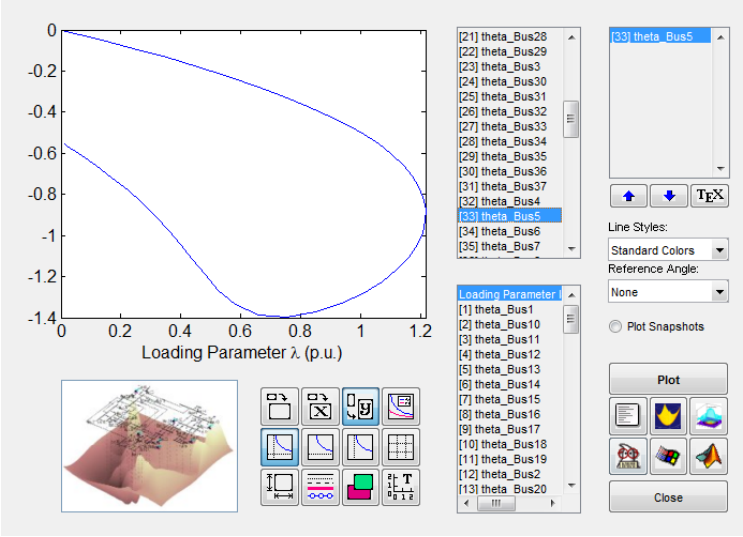

Fig.4 pv curve of at 5 th bus

B. WITH COMPENSATOR

5th bus is sensitive when compared to other buses, in the 5th bus the compensator is used for improving the voltage profile. Results shows that voltage profile increased at the bus as in the table 2, voltage profile in the figure, it also verified pv cuves of the sensitive bus using CPF and regression analysis fallowing the figures

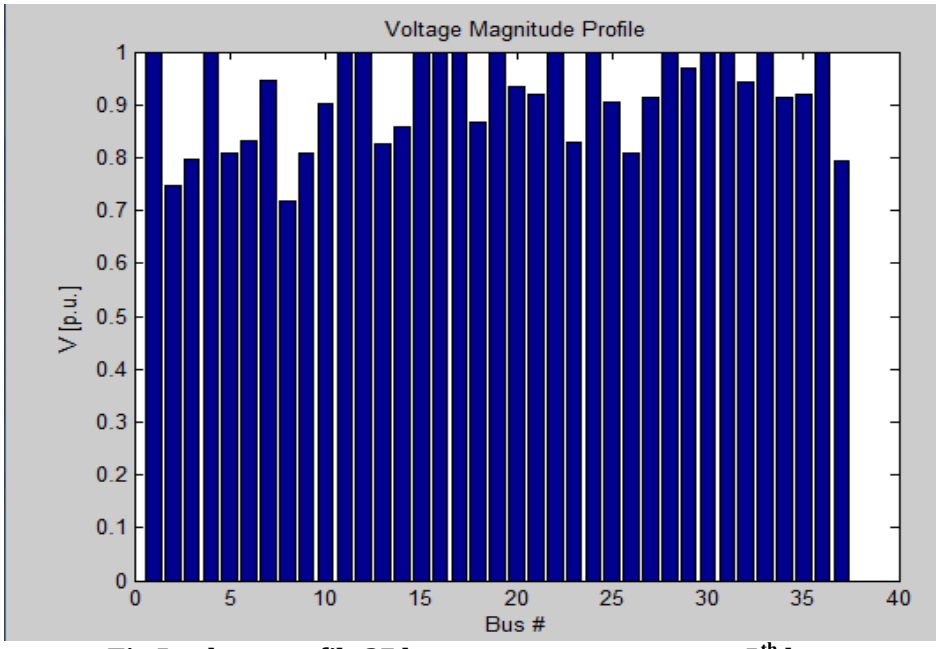

Fig.5 voltage profile 37 bus system compensator at 5th bus

Table 3 continues power flow results

24	POWER FLOW RESULTS						
25	Bus	V	phase	P gen	Q gen	P load	Q load
26		[p.u.]	[rad]	[p.u.]	[p.u.]	[p.u.]	[p.u.]
27	Bus1	1	0	25.312349	10.75916415	0	0
28	Bus10	0.644812135	-1.709507828	-1.554E-15	1.11022E-16	1.094223437	0.820667578
29	Bus11	0.715825663	-1.674731385	0	-6.6613E-16	1.094223437	0.820667578
30	Bus12	1	-1.594224001	2.18844687	10.66558672	0	0
31	Bus13	0.737037344	-1.685618818	-6.661E-16	1.66533E-15	1.094223437	0.820667578
32	Bus14	0.770993421	-1.678024015	-8.882E-16	-1.3323E-15	1.094223437	0.820667578
33	Bus15	0.920159598	-1.728079996	-1.998E-15	-5.5511E-16	1.094223437	0.820667578
34	Bus16	0.653080393	-1.184141477	2.4425E-15	-1.2212E-15	1.094223437	0.820667578
35	Bus17	0.767480698	-1.545172812	2.2204E-15	-3.3307E-16	1.094223437	0.820667578
36	Bus18	0.871599751	-1.693314336	-1.554E-15	-1.8874E-15	1.094223437	0.820667578
37	Bus19	1	-1.981064433	1.5543E-15	3.11906399	1.094223437	0.820667578
38	Bus2	1	-1.480681468	2.18844687	4.912279231	0	0
39	Bus20	0.775207087	-1.546421589	-2.22E-16	5.55112E-15	1.094223437	0.820667578
40	Bus21	0.814878131	-1.558745696	-1.998E-15	1.9984E-15	1.094223437	0.820667578
41	Bus22	1	-1.634697704	4.4409E-16	2.277614191	0	0
42	Bus23	1	-1.464065867	2.18844687	3.22239146	0	0
43	Bus24	1	-1.450699696	-1.475E-15	0.000793726	0	0
44	Bus25	0.827613838	-1.575198535	6.6613E-16	-1.7764E-15	1.094223437	0.820667578
45	Bus26	1	-1.437279707	0	5.666257374	1.094223437	0.820667578
46	Bus27	0.921904307	-1.323470391	-1.554E-15	-4.5519E-15	1.094223437	0.820667578
47	Bus28	0.914046292	-1.446043735	2.6645E-15	-3.8858E-15	1.094223437	0.820667578
48	Bus29	1	-1.502943126	2.18844687	1.941981132	0	0
49	Bus3	1	-0.984088999	2.18844687	4.693867904	0	0
50	Bus30	1	-1.620783258	0	1.824971203	1.094223437	0.820667578
51	Bus31	0.917348973	-1.618703585	-1.332E-15	3.21965E-15	1.094223437	0.820667578
52	Bus32	0.790801669	-1.758687554	8.8818E-16	-1.2212E-15	1.094223437	0.820667578
53	Bus33	0.88890717	-2.236219026	-2.22E-16	-8.8818E-16	1.094223437	0.820667578
54	Bus34	1	-2.122101771	2.8866E-15	4.052730156	1.094223437	0.820667578
55	Bus35	0.961157539	-2.23708788	6.6613E-16	-1.6653E-15	1.094223437	0.820667578
56	Bus36	1	-2.126531748	2.18844687	1.157849535	1.094223437	0.820667578
57	Bus37	1	-2.357119411	0	1.387171151	1.094223437	0.820667578
58	Bus4	0.967277466	-1.531751849	3.7748E-15	-1.4433E-15	1.094223437	0.820667578
59	Bus5	1	-1.002243331	3.1086E-15	8.579688802	0	0
60	Bus6	1	-1.511227524	1.09422344	2.894931393	1.094223437	0.820667578
61	Bus7	0.932006036	-1.387106687	2.2204E-16	6.32827E-15	1.094223437	0.820667578
62	Bus8	1	-1.476396951	2.18844687	1.927068022	0	0
63	Bus9	0.713028882	-1.63806592	1.7764E-15	-6.6613E-16	1.094223437	0.820667578

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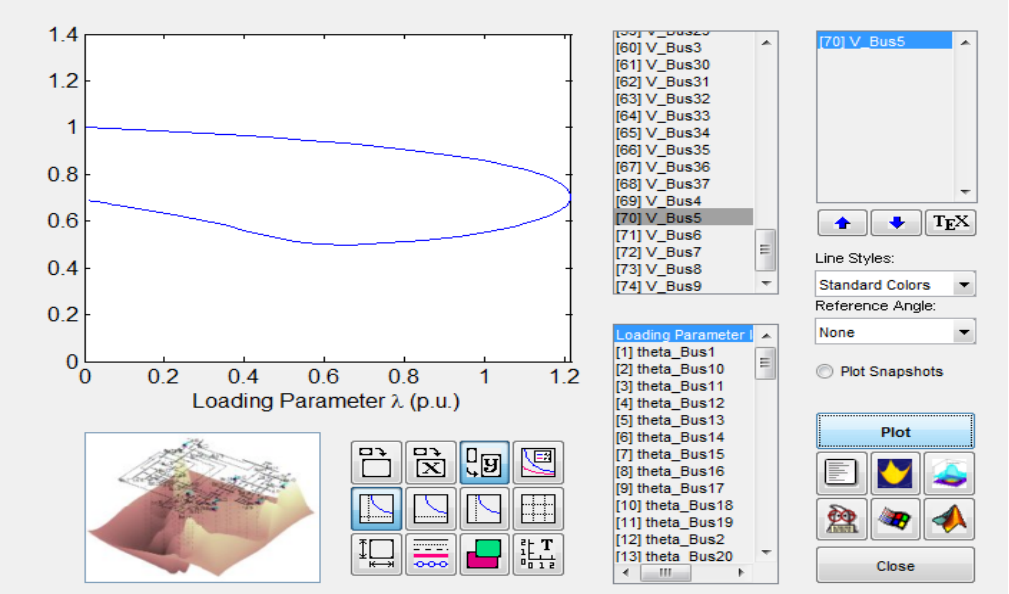

Fig.6 pv curve of at 5 th bus with compensator

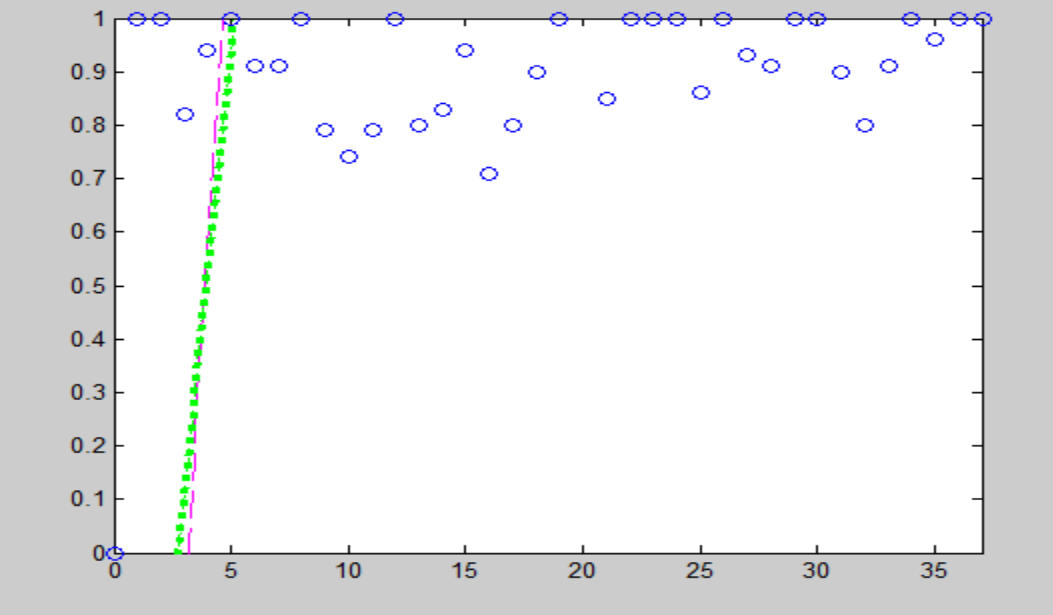

Fig.7 voltage profile with regression

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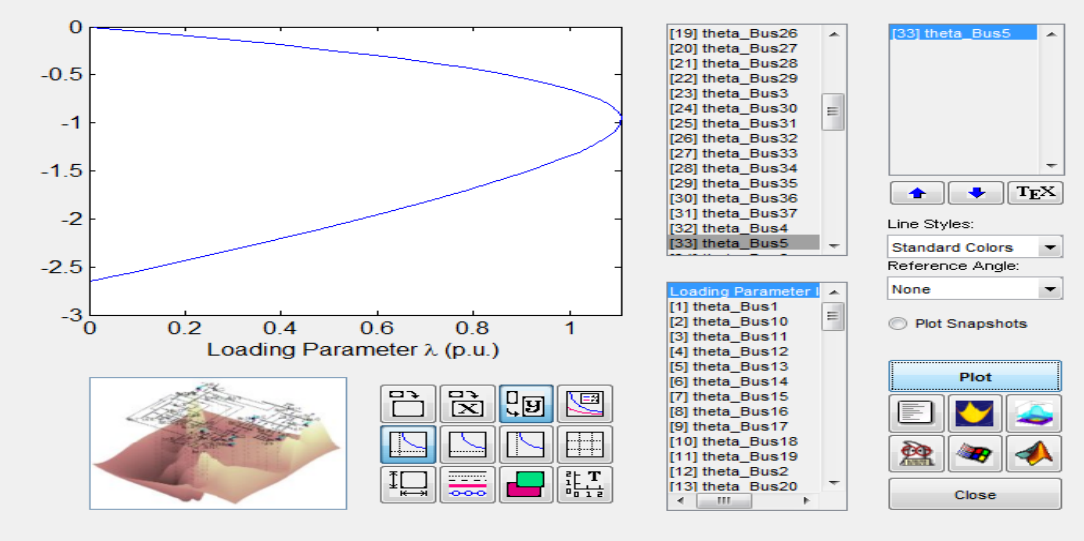

Fig.8 pv curve of at 5 th bus with compensator

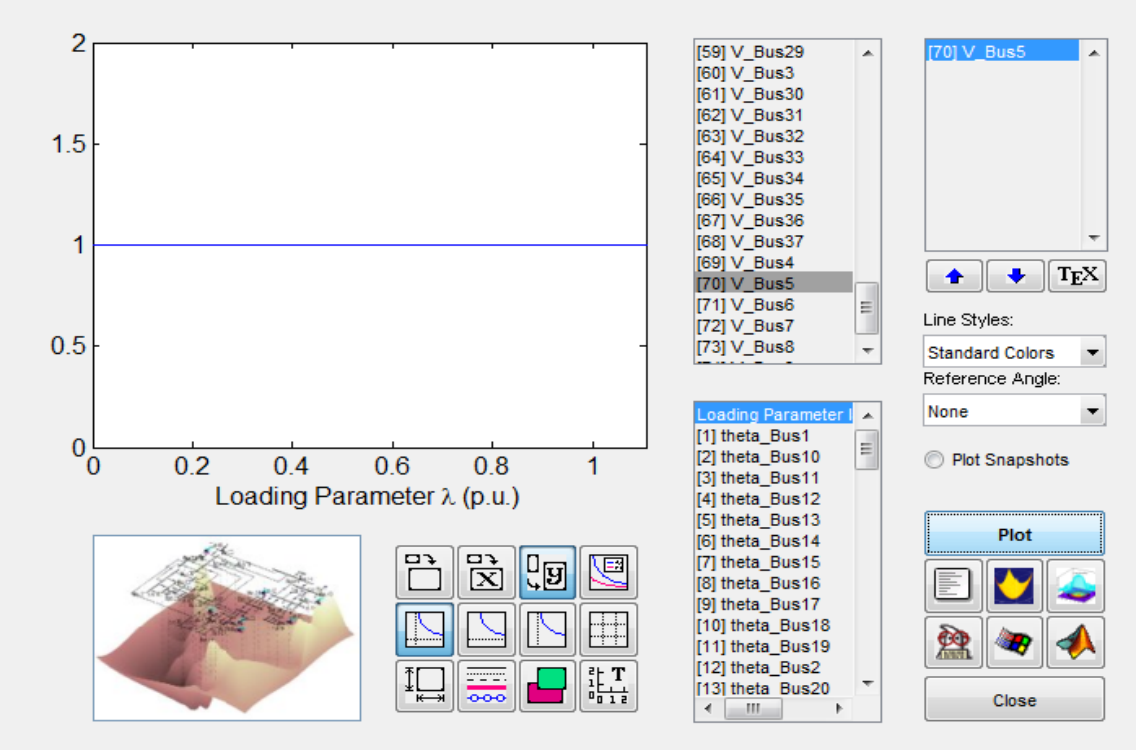

Fig.9 pv curve of at 5 th bus with compensator

VI. CONCLUSIONS

Against all above conversation and results unmistakably bus 5 the lowest value of voltage using CPF and regression analysis are studied. Voltage affectability examination is done and in the wake of figuring and eluding the charts it is cleared that transport 5 most basic transports and when exposed to change in burden may bring about voltage breakdown.With compensator 5th bus voltage profile increased with PV curves voltage profile data and regression analysis.

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