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Renewable and Dispatchable DG Allocation for Maximum Benefits

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ABSTRACT: This paper proposes a technique to evaluate the value of introducing renewable distributed generation (DG) in distribution networks. Moreover, the work ideally distributes these DG units in the distribution system to increase the value of the association to the local distribution company (LDC), and additionally the clients associated with the framework. The proposed concept helps the LDC to better evaluate the advantages of the renewable DG units proposed associations and to recognize the ideal transports on which to unite these DG units. The advantages considered in this paper are deferral of upgrade investments, diminishment of the cost of energy losses, and reliability improvement, it is portrayed by the cost of interruption. The proposed methodology thinks seriously about the uncertainty and variability connected with the output power of renewable DG as well as the load variability. In this paper both G.A and P.S.O methods are used and compared. The P.S.O method is more efficient than the G.A when it compared in the aspects of reduction of energy losses and overall savings to the system.

I. INTRODUCTION

At present the world facing the challenges in electricity generation and recent reorganize of energy systems, renewable DG plays an key role. Renewable vitality assets are the main choice to a supportable vitality supply foundation since they are neither exhaustible nor polluting [1]. Inappropriate placing of DG units in the conveyance system may prompt negative impacts; accordingly, the settlement of a high penetration of DG units in the force system must be arranged carefully through portion of these DG units to augment their advantages without disregarding framework limitations. The primary advantage is to remove the congestions in system feeders and concede the already obliged system upgrades. A[2] multi-period ideal force stream was utilized for ideal allotment of DG units in a dissemination system. A [3] philosophy was produced for ideal allotment of shunt capacitors to expand the investment funds from decreased losses.

The second advantage of introducing DG units in the distribution system is the reducing of energy losses. Some work proposed the arrangement of DG units for minimizing power losses in the framework [4], where a period changing burden and DG force were considered. A methodology was proposed [5] for discovering the ideal size what's more, power variable of four types of dispatchable DG units.

On [3] the other hand, lessening the aggregate yearly vitality misfortunes is not a precise representation of LDC necessities; however the charge of yearly vitality misfortunes is the element which must be considered [1].

The third advantage is enhanced reliability of the power supply for different clients. The greater parts of the previously mentioned productions have not examined the effects of DG units on synchronous machine reliability. For example, an ideal arrangement of DG units for most extreme change of framework unwavering quality is proposed. A [6] multi-target method was produced for ideal portion of DG considering framework unwavering quality.

II. PROBLEM DESCRIPTION

In this segment the framework expenses considered in the proposed long haul arranging issue are portrayed.

A. Frame work Upgrade Costs:

Framework overhaul cost in this work is considered as the total of lines protection and metering gear update costs. It is accepted that the principle substation transformers are repetitive, which is a typical practice in Ontario, Canada. The considered expenses are portrayed as follows:

1) Lines support costs:

Because of burden development, lines or link redesigns may get to be crucial. Likewise, lines overhaul can be utilized to keep away from violation of voltage and to build framework security. In the event that precisely arranged, introducing DG units can ease congestion on feeders; accordingly, it can concede these redesigns.

2) Protection and metering gear updates:
Because of high penetration of DG, reverse power flow at the substation can happen. Likewise, metering gear at the substation should be upgraded. Additionally, introducing DG units in the framework adds to the short circuit levels and may oblige redesigning the defensive gear.

B. Expense of Energy Losses:
Introducing DG units in a circulation system influences the energy losses, be that as it may because of the variability of burden, energy costs and DG units yield control, the cost of yearly energy losses must be computed hourly. This implies that the load flow analysis must be performed Y*8760 times, where Y is the quantity of situations.

C. Cost of Interruption:
The distribution framework is a vital connection between the transmission-era system and customers. Most of the time, these connections are radial, which makes them vulnerable to blackout because of the disappointments of a solitary component. Measurements investigated by the Canadian Electrical Association demonstrate that right around 80% of the blackouts seen by Canadian utility clients is because of the circulation framework [7].

III. GENERATION AND LOAD MODELING

In this area the area and burden demonstrating are portrayed, where the accompanying presumptions are made.

• Hourly normal load and wind speed information are considered in this work and the variations within hour are ignored.
• Wind DG yield power and burden are demonstrated as a multistate variables, where the quantity of states speaks to a exchange off in the middle of exactness and multifaceted nature of the arranging issue.

A. Wind Generation Modeling:
The energy losses and expense of interference, because of the variable hourly cost of vitality what's more, the non-straight cost harm capacity. Then again, a probabilistic wind velocity model is utilized for assessing the expenses of redesign [9,10].

B. Dispatchable DG Unit Modeling:
Dispatchable DG units can be isolated into two gatherings: synchronous machine based (as diesel and natural gas based DG) furthermore, inverter based (as energy component and small scale turbine based DG). In this work, natural gas DG units are considered. The yield of these DG units is thought to be settled in ordinary method of operation. In any case, amid islanding mode the yield of these DG units is thought to be shifted to deal with the dynamic and responsive force equalization. A two-state-model is utilized to display the operation of every DG [8].

C. Load Modeling:
The heap in the appropriation system under study is accepted to take after the IEEE reliability test framework burden design.[9] The burden is demonstrated by a clear number of states relying upon coveted precision, time scale and pace of reenactment.

IV. PROBLEM FORMULATION

In this area the proposed DG arranging issue definition is exhibited, which is classified nonlinear programming. The accompanying presumptions are made.

• Most of the utilities drive the DG units to work in steady force component mode. Subsequently, the DG units are expected to work at solidarity force component [1].
• DG units' abilities are discretized at a distinct step, which is thought to be 100 kW in the exhibited work.

For joining the impact of DG units' establishment on framework overall, energy losses and reliability, the run of the mill costs in Canadian dollars are utilized for every individual target. In the following area GA is used to locate the ideal sizes and areas of DG units to minimize the goal capacity. The proposed arranging issue is depicted by the accompanying.

Target capacity:
Minimize:
Cost = Cost(s) of Objective (s)

$$+10^8 \sum_{c}^{nc} X_c - Incentives \qquad (1)$$

Where X_c is a twofold variable comparing to requirement (the second term speaks to a punishment variable for damaging requirement); nc is the aggregate number of requirements.
The motivators here are thought to be a cash quality got by the LDC for each renewable MW associated with the framework. The cost(s) of objective(s) in (1) can be the individual cost or entirety of distinctive expenses as depicted in next subsections.
Force stream imperatives:

$$PG_{isy} - PL_{isy} = \sum_{k=1}^{n} V_{isy} V_{ksy} Y_{ik}$$

$$\text{X Cos } (\theta_{ik}+\delta_{ksy} - \delta_{isy}) \ \forall_{i,s,y} \qquad (2)$$

$$QG_{isy} - QL_{isy} = -\sum_{k=1}^{n} V_{isy} V_{ksy} Y_{ik}$$

$$\text{X sin } (\theta_{ik}+\delta_{ksy} - \delta_{isy}) \ \forall_{i,s,y} \qquad (3)$$

where 'i' and 'k' are the transport number; n is the aggregate number of transports in the framework under study; 's' is the state number; 'y' is the year under study; P_L and Q_L are the dynamic and responsive force requests; P_G and Q_G are the dynamic and receptive produced powers.
Voltage limits requirements:

$$V_{min} \le V_{ixy} \le V_{max} \ \forall_{i,s,y} \qquad (4)$$

Most extreme entrance:
Most extreme entrance is taken in order to utmost greatest opposite force stream at 60% of substation rating amid least burden condition:

$$S=\begin{bmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

where, $P_{DGD,}$ $P_{DGW,}$ and P_{main} are the produced force from dispatchable DG units, wind DG units and principle substation, separately.

Discrete size of DG units:

$P_{DGD,} = g_i$ x a_i x 0.1MW $\forall_i \in DGB$ (6)

$P_{DGW,} = w_i$ x b_i x 0.1MW $\forall_i \in DGB$ (7)

where a_i and b_i are whole number variables; g_{ij} and w_{ij} are double variables demonstrating the choice of introducing dispatchable DG unit what's more, wind based DG unit at transport i_i, individually.

Candidate busses:

$g_i = 0_i$ $w_i = 0$ $\forall_i \in AllB - DGB$ (8)

Where AllB and DGB are sets of all transports and applicant transports, seperately.

DG units limit

$$\sum_{i=1}^{n} g_i \le M_{Di} \sum_{i=1}^{n} w_i \le M_W \qquad (9)$$

Where M_D and M_W are the most extreme number of DG units introduced in the framework for dispatchable and wind based DG, individual.

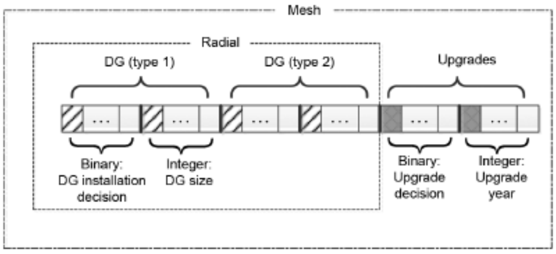


Fig.1. Structure of a typical chromosome in the proposed planning problem.

A. Framework Upgrades:

This subsection portrays the technique proposed for assessing the expense of framework designs. A risk factor (RF) is proposed which speaks to the expected duration of over loading every year. This variable is utilized as a part of assessing the expense of lines' redesigns.

1) Lines upgrades

For radial frameworks, considering the no DG case, the support expenses can be assessed at the great state of force stream in the lines, which is basically one condition at crest burden, as the force stream is dependably from the substation to the load point.

2) Metering equipment upgrade

At the substation terminals where the metering devices are introduced, the direction of power flow is checked under the condition of minimum load and rated DG output. As needs be, the expense of updating the metering devices is determined.

3) Protection switch apparatus redesign

To avoid false tripping and for successful fault clearing, a short circuit analysis of the framework must be done in the vicinity of introduced DG units. In this way cost of upgrading the protective equipments evaluated.

B. Expense of Energy Loss:

The power loss for every condition of the load states is calculated for 20 years with load growth. At that point, the expense of the yearly energy losses is assessed for every year as per the procedure. The power loss for every year is spoken to as a vector of length Ns in which every component speaks to the force misfortune comparing to state:

$P_{lossy} = [P_{loss1}\ P_{loss2..}\ P_{lossN3}]$ (10)

A parallel variable is characterized as

$S_z = [\,]_{8760XNs,}\ \forall_z = 1,2,\ldots, N_y$ (11)

Where N_s the aggregate is number of conditions of the consolidated burden and era model; N_y is the aggregate number of situations in the probabilistic ordered model.

The state number speaks to the areas of the ones in the columns of the parallel variable S which is given by

$$S=\begin{bmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \qquad (12)$$

The expense of yearly energy losses is assessed by

$$C_{E_{loosy}} = \left(\frac{1}{N_y}\right)$$

$$X \sum_{Z=1}^{N_y} \left([S_z]_{8760\times N_y}\, X \left[P_{loosy}\right]_{Nz\times 1} \right)^T XC_{8760\times 1} \quad (13)$$

Where C_{Elossy} is the expense of yearly vitality misfortunes for year y.

At long last, the NPV of the aggregate expense of vitality misfortunes for the period under study is assessed by Vector C represents the hourly energy price in $/kwh for the 8760hrs.The hourly market clearing prices of electric energy in 2010 from the IESO website [15] are utilized as vector C.

$$NPV_{loss} = \sum_{y=1}^{Y_{rs}} \frac{C_{Elossy}}{(1+d)^y} \qquad (14)$$

C. Expense of Interruption:

The distributed network normally contains a mix of private, business and modern clients. The expense of interference, which is known as the cost of damage function (CDF), is not straight and shifts as per the span of intrusion, which demonstrates the normal expense of intrusion assessments got as a component of interference term for every client part.

Since the CDF is not direct, the blackout taken a toll can't be assessed, the blackout expense is assessed utilizing

$$CostO_i = \left(\frac{1}{N_y}\right) \times \left(\sum_{k-1}^{N_i} CDF(U_k)\right) \times P_{loadi} \qquad (15)$$

where $CostO_i$ is the blackout expense of the load point 'i'; $CDF(U_k)$ is the blackout expense comparing to intrusion occasion 'k'; N_i is aggregate number of interruption occasions for burden 'i'; $P_{load\ i}$ is the heap point 'i' average demand power.

In the aforementioned technique to assess the commitment of DG to the interference expense of diverse clients, the CDF is thought to be steady for certain span of blackout.

The expense of interference for a certain heap point could be assessed utilizing [9,10]

$$CostO_i = \left(\frac{1}{N_y}\right) \times \sum_{k=1}^{N_i} \sum_{t=1}^{T_k} CDF(U_k) \times P_{loadi} \times \frac{P_{pui}(t)}{T_k} \qquad (16)$$

Where T_k is the time in hours for blackout occasion 'k'; $P_{pu\ i}$ (t) is the per unit burden power at time for burden point 'i'.

$$NPV_{INT} = \sum_{y=1}^{Y_{rs}} \frac{\sum_{i=1}^{n} CostO_{iy}}{(1+d)^y} \qquad (17)$$

V. CASE STUDY

Consider the distribution system under study[18], which contains a mix of private, business and mechanical clients being supplied from a typical supply point, which is like the Canadian appropriation as demonstrated in Fig. 2. The framework information and kind of clients are accessible. The downright framework crest burden is 4.37 MVA separated into five fragments. Applicant DG transport areas are dictated by point by point arranging examination including specialized, natural and monetary studies, which is accepted as a data and are past the extent of the work displayed in this project.

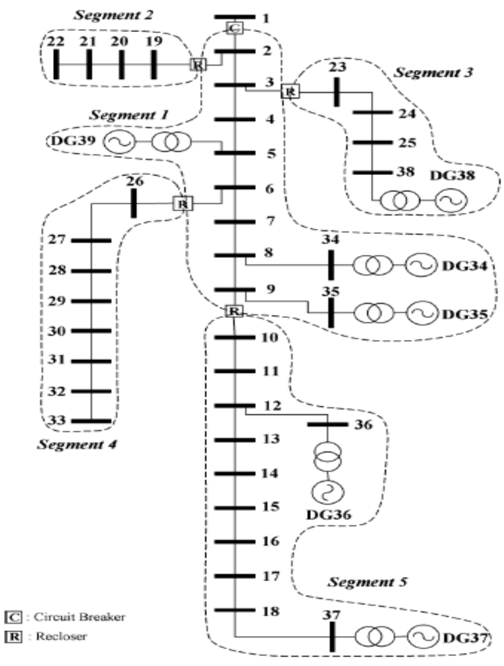
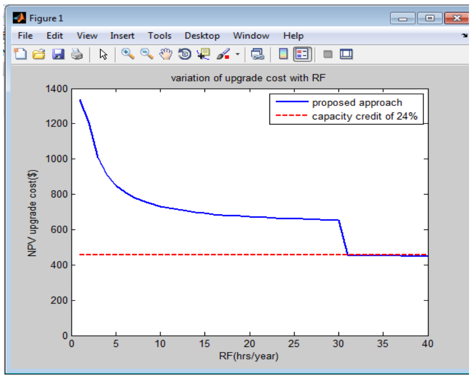


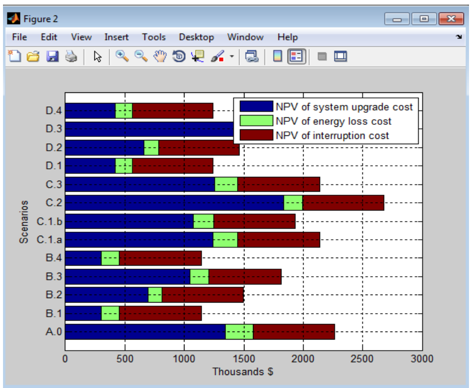
Fig.2. System under study.

The applicant transports chosen in the displayed contextual analysis are absolutely discretionary and are situated as demonstrated in Fig. 2. As indicated by the area of the applicant transports, islanding is powerful in lessening the expense of intrusion just for fragments 3 and 5. With the end goal of specialized assessment of the DG units' impact on unwavering quality, the normal vitality not served (EENS) of the framework is assessed as given [13]. Greatest number of DG units in the framework is constrained to 5 units for every sort of DG, as depicted in (9).

RESULTS



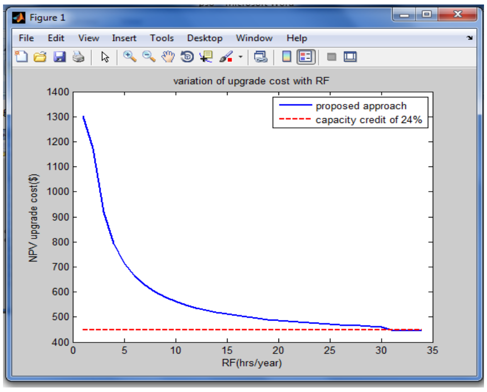
Variation of upgrade costs with RF.



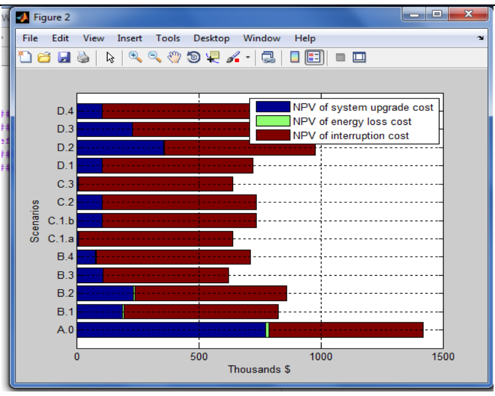
Results of different scenarios

The extension of the given proposed system is done by reducing the IEEE 38 Bus to IEEE33Bus by using Genetic Algorithm(G.A).

EXTENSION:

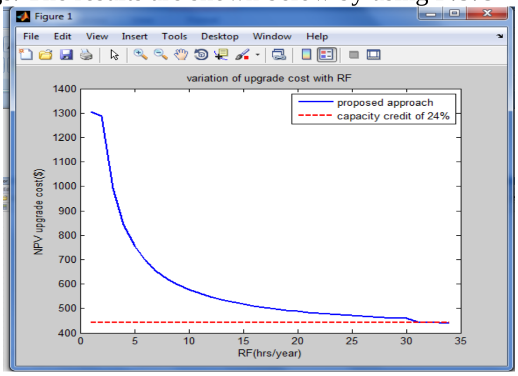


Variation of upgrade costs with RF

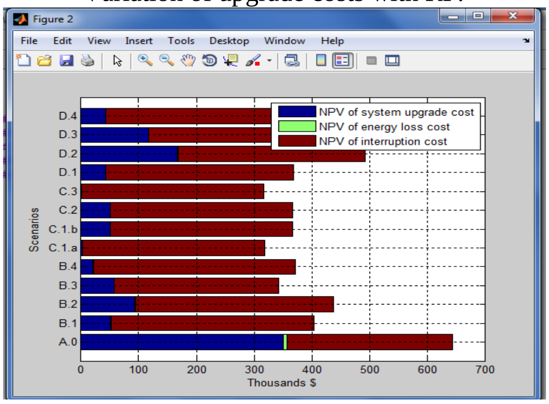


Results of different scenarios

For this system if we apply the Particle Swarm Optimization (P.S.O) technique we can reduce the energy losses and we can maximize the savings. The results are shown below by using P.S.O



Variation of upgrade costs with RF.



Results of different scenarios

DGtype		No DG	Dispatchable				Wind				Wind and Dispatchable							
Scenario		A.0	B.1	B.2	B.3	B.4	C.1.a	C.1.b	C2	C3	D.1		D.2		D.3		D.4	
Objective			UG	EL	INT	UG+EL+INT	UG RF=3/8760	UG RF=6/8760	EL	UG+EL	UG		UG		UG		UG	
											Dip	Wind	Dip	Wind	Dip	Wind	Dip	Wind
Installed DG units (MW) at candi-date buses	DG 28	0.0	0.4	0.2	0.1	0.4	0.1	0.2	0.3	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.1	0.1
	DG 29	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.4	0.1	0.1	0.0	0.0	0.0	0.3
	DG 30	0.0	0.1	0.0	0.5	0.2	0.2	0.0	0.1	0.1	0,2	0.0	0.0	0.2	0.4	0.4	0.0	0.2
	DG 31	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.2	0.2	0.0	0.1
	DG 32	0.0	0.0	0.2	0.1	0.0	0.3	0.4	0.5	0.0	0.1	0.1	0.1	0.0	1.1	0.5	0.1	0.1
	DG 33	0.0	0.0	0.8	0.9	0.0	0.1	1.2	1.2	0.1	0.0	0.1	0.5	0.6	0.0	0.1	0.1	0.0
Total penetration(MW)		0.0	0.9	2.0	1.9	0.9	0.7	2.9	3.0	0.7	0.9	0.6	1.5	1.1	1.7	1.2	0.9	0.6
NPV of cost of syste-m upgrades	Lines upgr-ade ($)	1341507.68	302806.97	597135.03	946653.80	302806.97	1242762.68	975172.38	173719 8.35	1253026.36	357498.07		379657.90		1484235.11		357498.07	
	Meatering upgrade($)	0.00	0.00	40000.00	40000.00	0.00	0.00	40000.00	40000.00	0.00	0.00		40000.00		40000.00		0.00	
	Protection upgrade($)	0.00	0.00	60000.00	60000.00	0.00	0.00	60000.00	60000.00	0.00	60000.00		240000.00		180000.00		60000.00	
	Total ($)	1341507.68	302806.97	697135.03	1046653.80	302806.97	1242762.68	1075172.38	1837198.35	1253026.36	417498.07%		659657.90		1704235.11		417498.07	
	% saving	0.00%	77.43%	48.03%	21.98%	77.43%	7.36%	19.85%	-36.95%	6.60%	68.88%		50.83%		-27.04%		68.88%	
NPV of cost of energy losses	Cost ($)	234546.99	150416.01	116430.70	157915.20	150416.01	206033.44	171468.41	154664.36	198582.90	144029.46		121497.96		183626.44		144029.46	
	% saving	0.00%	35.87%	50.36%	32.67%	35.87%	12.16%	26.89%	34.06%	15.33%	38.59%		48.20%		21.71%		38.59%	
NPV cost of interuption	Segment1 ($)	106800.00	106800.00	106800.00	106800.00	106800.00	106800.00	106800.00	106800.00	106800.00	106800.00		106800.00		106800.00		106800.00	
	Segment2 ($)	36000.00	36000.00	36000.00	36000.00	36000.00	36000.00	36000.00	36000.00	36000.00	36000.00		36000.00		36000.00		36000.00	
	Segment3 ($)	195300.00	195300.00	190650.00	186000.00	195300.00	195300.00	195300.00	195300.00	195300.00	186000.00		186000.00		195300.00		186000.00	
	Segment4 ($)	220800.00	220800.00	220800.00	220800.00	220800.00	220800.00	220800.00	220800.00	220800.00	220800.00		220800.00		220800.00		220800.00	
	Segment5 ($)	129150.00	129150.00	126075.00	62115.00	129150.00	129150.00	129150.00	129150.00	129150.00	129150.00		128535.00		129150.00		129150.00	
	Total ($)	688050.00	688050.00	680325.00	611715.00	688050.00	688050.00	688050.00	688050.00	688050.00	678750.00		678135.00		688050.00		678750.00	
	% saving	0.00%	0.00%	1.12%	11.09%	0.00%	0.00%	0.00%	0.00%	0.00%	1.35%		1.44%		0.00%		1.35%	
Total cost($)		2264104.6	114127	140161	179261	114127			257991	2139659.26			1189205.87		2355911.55		1189577.52	

	7	2.97	5.73	9.00	2.97	2136846.12	1834690.79	2.71		1189577.52			
%Total savings	0.00%	49.59%	38.09%	20.82%	49.59%	5.62%	18.97%	-13.95%	5.5%	47.46%	47.48%	-4.05%	47.46%

DGtype		No DG	Dispatchable				Wind				Wind and Dispatchable							
Scenario		A.0	B.1	B.2	B.3	B.4	C.1.a	C.1.b	C2	C3	D.1		D.2		D.3		D.4	
Objective			UG	EL	INT	UG+EL+INT	UG	UG	EL	UG+EL	UG		UG		UG		UG	
							RF=3/8760	RF=6/8760			Dip	Wind	Dip	Wind	Dip	Wind	Dip	Wind
Installed DG units (MW) at candi-date buses	DG 28	0.1	0.4	0.2	0.1	0.4	0.1	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1
	DG 29	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.3	0.1	0.1	0.1	0.1	0.0	0.3
	DG 30	0.2	0.2	0.0	0.5	0.2	0.2	0.0	0.1	0.1	0.0	0.2	0.0	0.2	0.2	0.2	0.0	0.2
	DG 31	0.1	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.1
	DG 32	0.2	0.0	0.2	0.9	0.0	0.3	0.4	0.5	0.0	0.1	0.1	0.1	0.0	0.9	0.3	0.1	0.1
	DG 33	0.1	0.0	0.8	0.1	0.0	0.1	1.2	1.2	0.1	0.1	0.1	0.5	0.6	0.1	0.0	0.1	0.0
Total penetration(MW)		0.0	0.9	2.0	1.9	0.9	0.7	2.9	3.0	0.7	0.9	0.6	1.5	1.1	1.7	1.2	0.9	0.6
NPV of cost of syste-m upgrades	Lines upgr-ade ($)	772937.75	92350.40	65569.08	2816.56	36940.16	5230.95	2499.09	934.79	1958.49	20380.41		37889.52		3193.24		20380.41	
	Meatering upgrade($)	0.00	0.00	40000.00	40000.00	0.00	0.00	40000.00	40000.00	0.00	0.00		40000.00		40000.00		0.00	
	Protection upgrade($)	0.00	0.00	60000.00	60000.00	0.00	0.00	60000.00	60000.00	0.00	60000.00		240000.00		180000.00		60000.00	
	Total ($)	772937.75	92350.40	165569.08	102816.56	36940.16	5230.95	102499.09	100934.79	1958.49	80380.41		317889.62		223193.24		80380.41	
	% saving	0.00%	88.05%	78.58%	86.70%	95.22%	99.32%	86.74%	86.94%	99.75%	89.60%		58.87%		71.12%		89.60%	
NPV of cost of energy losses	Cost ($)	13541.87	3235.96	2871.93	123.37	1617.98	171.84	82.10	30.71	171.56	892.66		1659.57		139.86		892.66	
	% saving	0.00%	76.10%	78.79%	99.09%	88.05%	98.73%	99.39%	99.77%	98.73%	93.41%		87.74%		98.97%		93.41%	
NPV cost of interfruption	Segment1 ($)	128400.00	128400.00	128400.00	128400.00	128400.00	128400.00	128400.00	128400.00	128400.00	128400.00		128400.00		128400.00		128400.00	
	Segment2 ($)	36000.00	36000.00	36000.00	36000.00	36000.00	36000.00	36000.00	36000.00	36000.00	36000.00		36000.00		36000.00		36000.00	
	Segment3 ($)	264600.00	264600.00	258300.00	252000.00	264600.00	264600.00	264600.00	264600.00	264600.00	252000.00		252000.00		264600.00		252000.00	
	Segment4 ($)	202650.00	202650.00	197825.00	97465.00	202650.00	202650.00	202650.00	202650.00	202650.00	202650.00		201685.00		202650.00		202650.00	

	Total ($)	631650.00	631650.00	620525.00	513865.00	631650.00	631650.00	634231.19	631650.00	631650.00	619050.00	618085.00	631650.00	619050.00
	% saving	0.00%	0.00%	1.76%	18.65%	0.00%	0.00%	0.00%	0.00%	0.00%	1.99%	2.15%	0.00%	1.99%
Total cost($)		1418129.62	727236.35	700091.00	634589.93	670208.14	637052.78	634231.19	632615.50	633780.05	652923.07	671199.19	634983.10	652923.07
%Total savings		0.00%	48.72%	50.63%	55.25%	52.74%	55.08%	55.28%	55.39%	55.31	53.96%	52.67%	55.22%	53.96%

The **first** table shown here is the 33 bus system by using **Genetic algorithm**.
The **second** table shown here is the 33 bus system by using the **P.S.O**

CONCLUSION

In this project, a multi-target improvement methodology based on GA for ideal portion of diverse sorts of DG units into the appropriation framework is proposed. The main objective is to maximize savings in framework updates investment deferral, expenses of annual energy loss and cost of interruption. The advantages of DG connection are represented in money value to encourage correlation and to withhold from utilizing weighting elements, which are generally misleading the results. The proposed technique is taking into account producing probabilistic furthermore.

The uncertainty of the renewable DG units' output is taken in to consideration, as well as type of load. The system's technical constraints, protection equipment upgrade, metering equipment upgrade, and different customers' interruption costs are all considered. Moreover, this work presents a new approach for evaluating the upgrade requirements in presence of renewable DG in the distribution systems, where a new factor is introduced to represent the risk of overloading system lines. This method is assumed more accurate estimate of the energy losses in long term planning problems, particularly with renewable DG units.

The comparison is made between the G.A and P.S.O. From this we can say that the energy losses can reduced more by using P.S.O and maximize the savings over the G.A. Hence the P.S.O technique is accurate.

REFERENCES

[1]. Y. M. Atwa, E. F. El-Saadany, M. M. A. Salama, and R. Seethapathy, "Optimal renewable resources mix for distribution system energy loss minimization," IEEE Trans. Power Syst., vol. 25, no. 1, pp. 360–370,Feb. 2010.

[2]. A. Piccolo and P. Siano, "Evaluating the impact of network investment deferral on distributed generation expansion," IEEE Trans. Power Syst., vol. 24, no. 3, pp. 1559–1567, Aug. 2009.

[3]. H.M. Khodr, F.G.Olsina, P. M. De Oliveira-De Jesus, and J. M.Yusta,"Maximum savings approach for location and sizing of capacitors in distribution systems," *Elect. Power Syst. Res., Elsevier*, vol. 78, no. 7,pp. 1192–1203, Jul. 2008.

[4]. C. Wang andM. H. Nehrir, "Analytical approaches for optimal placement of distributed generation sources in power systems," *IEEE Trans.Power Syst.*, vol. 19, no. 4, pp. 2068–2076, Nov. 2004.

[5]. D. Q. Hung, N. Mithulananthan, and R. Bansal, "Analytical expressions for DG allocation in primary distribution networks," *IEEE Trans.Energy Convers.*, vol. 25, no. 3, pp. 814–820, Sep. 2010.

[6]. Y. Attwa and E. El-Saadany, "Reliability based analysis for optimum allocation of DG," in *Proc. IEEE Canada Elect. Power Conf., EPC 2007*, 2007, pp. 25–30.

[7]. Canadian Electricity Association. [Online]. Available: http://www.electricity.ca.

[8]. *IEEE Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power Systems*, IEEE Std. 1547.4,2011.

[9]. Y. M. Atwa and E. F. El-Saadany, "Reliability evaluation for distribution system with renewable distributed generation during islanded mode of operation," *IEEE Trans. Power Syst.*, vol. 24, no. 2, pp.572–581, May 2009.

[10]. S. H. Jangamshetti and V. G. Rau, "Site matching of wind turbine generators:A case study," *IEEE Trans. Energy Convers.*, vol. 14, no. 4,pp. 1537–1543, Dec. 1999.

[11]. R. Billinton and W. Li, *Reliability Assessment of Electric Power Systems Using Monte Carlo Methods*. New York: Plenum, 1994.

[12]. Y. Hegazy, M. Salama, and A. Chikhani, "Adequacy assessment of distributed generation systems using Monte Carlo simulation," *IEEE Trans. Power Syst.*, vol. 18, no. 1, pp. 48–52, Feb. 2003.

[13]. IEEE RTS Task Force of APM Subcommittee, "The IEEE reliability test system-1996," *IEEE Trans. Power Syst*, vol. 14, no. 3, pp.1010–1020, Aug. 1999.

[14]. [Online]. Available:http://www.ieso.ca.

[15]. D. Singh and R.Misra, "Effect of load models in distributed generation

planning," *IEEE Trans. Power Syst.*

DGtype		No DG	Dispatchable				Wind				Wind and Dispatchable							
Scenario		A.0	B.1	B.2	B.3	B.4	C.1.a	C.1.b	C2	C3	D.1		D.2		D.3		D.4	
Objective			UG	EL	INT	UG+EL+INT	UG RF=3/8760	UG RF=6/8760	EL	UG+EL	UG		UG		UG		UG	
											Dip	Wind	Dip	Wind	Dip	Wind	Dip	Wind
Installed DG units (MW) at candi-date buses	DG 28	0.0	0.4	0.2	0.1	0.4	0.1	0.2	0.3	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.1	0.1
	DG 29	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.4	0.1	0.1	0.0	0.0	0.0	0.3
	DG 30	0.0	0.1	0.0	0.5	0.2	0.2	0.0	0.1	0.1	0,2	0.0	0.0	0.2	0.4	0.4	0.0	0.2
	DG 31	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.2	0.2	0.0	0.1
	DG 32	0.0	0.0	0.2	0.1	0.0	0.3	0.4	0.5	0.0	0.1	0.1	0.1	0.0	1.1	0.5	0.1	0.1
	DG 33	0.0	0.0	0.8	0.9	0.0	0.1	1.2	1.2	0.1	0.0	0.1	0.5	0.6	0.0	0.1	0.1	0.0
Total penetration(MW)		0.0	0.9	2.0	1.9	0.9	0.7	2.9	3.0	0.7	0.9	0.6	1.5	1.1	1.7	1.2	0.9	0.6
NPV of cost of syste-m upgrades	Lines upgr-ade ($)	1341507.68	302806.97	597135.03	946653.80	302806.97	1242762.68	975172.38	1737198.35	1253026.36	357498.07		379657.90		1484235.11		357498.07	
	Meatering upgrade($)	0.00	0.00	40000.00	40000.00	0.00	0.00	40000.00	40000.00	0.00	0.00		40000.00		40000.00		0.00	
	Protection upgrade($)	0.00	0.00	60000.00	60000.00	0.00	0.00	60000.00	60000.00	0.00	60000.00		240000.00		180000.00		60000.00	
	Total ($)	1341507.68	302806.97	697135.03	1046653.80	302806.97	1242762.68	1075172.38	1837198.35	1253026.36	417498.07%		659657.90		1704235.11		417498.07	
	% saving	0.00%	77.43%	48.03%	21.98%	77.43%	7.36%	19.85%	-36.95%	6.60%	68.88%		50.83%		-27.04%		68.88%	
NPV of cost of energy losses	Cost ($)	234546.99	150416.01	116430.70	157915.20	150416.01	206033.44	171468.41	154664.36	198582.90	144029.46		121497.96		183626.44		144029.46	
	% saving	0.00%	35.87%	50.36%	32.67%	35.87%	12.16%	26.89%	34.06%	15.33%	38.59%		48.20%		21.71%		38.59%	
NPV cost of interuption	Segment1 ($)	106800.00	106800.00	106800.00	106800.00	106800.00	106800.00	106800.00	106800.00	106800.00	106800.00		106800.00		106800.00		106800.00	
	Segment2 ($)	36000.00	36000.00	36000.00	36000.00	36000.00	36000.00	36000.00	36000.00	36000.00	36000.00		36000.00		36000.00		36000.00	
	Segment3 ($)	195300.00	195300.00	190650.00	186000.00	195300.00	195300.00	195300.00	195300.00	195300.00	186000.00		186000.00		195300.00		186000.00	
	Segment4 ($)	220800.00	220800.00	220800.00	220800.00	220800.00	220800.00	220800.00	220800.00	220800.00	220800.00		220800.00		220800.00		220800.00	
	Segment5 ($)	129150.00	129150.00	126075.00	62115.00	129150.00	129150.00	129150.00	129150.00	129150.00	129150.00		128535.00		129150.00		129150.00	
	Total ($)	688050.00	688050.00	680325.00	611715.00	688050.00	688050.00	688050.00	688050.00	688050.00	678750.00		678135.00		688050.00		678750.00	
	% saving	0.00%	0.00%	1.12%	11.09%	0.00%	0.00%	0.00%	0.00%	0.00%	1.35%		1.44%		0.00%		1.35%	

Total cost($)	2264104.67	1141272.97	1401615.73	1792619.00	1141272.97	2136846.12	1834690.79	2579912.71	2139659.26	1189577.52	1189205.87	2355911.55	1189577.52
%Total savings	0.00%	49.59%	38.09%	20.82%	49.59%	5.62%	18.97%	-13.95%	5.5%	47.46%	47.48%	-4.05%	47.46%