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An Analysis of Economic Load Dispatch in Power System Using Genetic Algorithm

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ABSTRACT: The objective of this paper is to solve an Economic Load Dispatch problem in Power System using Genetic Algorithm method. The Aim of this work is to minimize total fuel cost of generation. Data has been taken from the IEEE standard data sheet. Genetic Algorithm method is implemented in MATLAB.

KEYWORDS: Economic Load Dispatch; Genetic Algorithm; Lambda Iteration Method, Fuel Cost.

I. INTRODUCTION

Economic Load Dispatch problem is the most important optimization problem in modern power system. Main aim of economic load dispatch problem is allocation of power generation to different thermal units to minimize overall fuel cost while satisfying the load demand and operating constraints [1].
Conventional methods to solve the Economic Load Dispatch Problem are as follows : Lambda Iteration method, Linear Programming and Dynamic Programming [2]. These methods have some limitations when using with more complex problems [3]. Advanced techniques have been developed for solving optimization problems. Examples are Neural Network [4], the Simulated Annealing method [5], Fuzzy Logic and Genetic Algorithm and so on.

II.ECONOMIC LOAD DISPATCH

Economic Load Dispatch

The Economic Load Dispatch is the process of allocation of generation to different thermal units. The main goal of Economic Load dispatch is to minimize the overall fuel cost of generation [1].

Generator Operating Cost

The total cost includes the fuel cost, labour cost, supplies and maintenance. Costs of labour, supplies and maintenance are fixed. Figure 1 shows the N Thermal units committed to serve a load of $P_{load.}$ The Input to each unit, shows the Fuel Cost of the unit.The Total Fuel Cost is the sum of Fuel Cost of each of the individual units [6].

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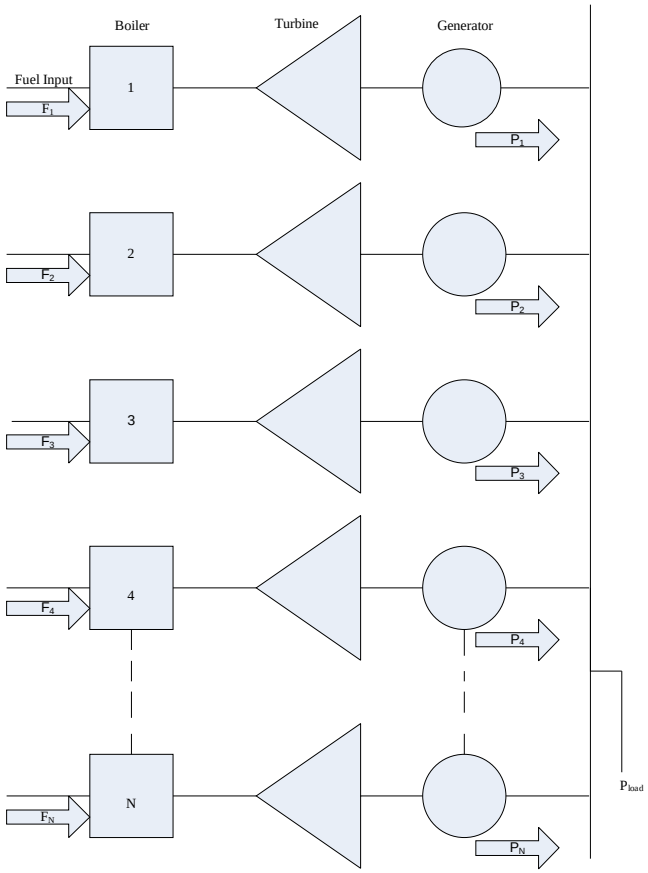

Fig.1. N Thermal units committed to serve a load of P_{load}

Figure 1 shows the N Thermal units committed to serve a load of $P_{load.}$

III.PROBLEM FORMULATION

Objective function

Fuel cost function is expressed as a quadratic function. The total fuel cost is given by

$$F(P_{gi}) = a_i P_{gi}*2 + b_i P_{gi} + c_i \text{ Rs/hr} , i= 1, 2 , 3 ,….n \quad (1)$$

Where a_i, b_i, c_i are cost coefficients for ith unit. $F_i(P_{gi})$ is the total fuel cost of generation. P_{gi} is the generation of ith unit [1].

Power balance constraint

Power generated should be same as the total load demand P_D (in MW).

$$P_D=\sum_{i=1}^{n} Pgi \quad (2)$$

The transmission and generator losses have been neglected [1].

Generation limits constraint

The output power of each generating unit has a upper and lower bound so that it is lies between these limits.

$$P_{gi}min \leq P_{gi} \leq P_{gi}max \quad (3)$$

Where $P_{gi}min$ and $P_{gi}max$ are minimum and maximum load demand of generator i, respectively [1].

IV.GENETIC ALGORITHM

The Fundamentals of Genetic Algorithm were first propped by Holland [7]. A Genetic Algorithm is a search technique used in solving to find exact or approximate solutions to optimization and search problems. Genetic Algorithm is a part of Evolutionary Algorithm.

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Flow Chart of Genetic Algorithm

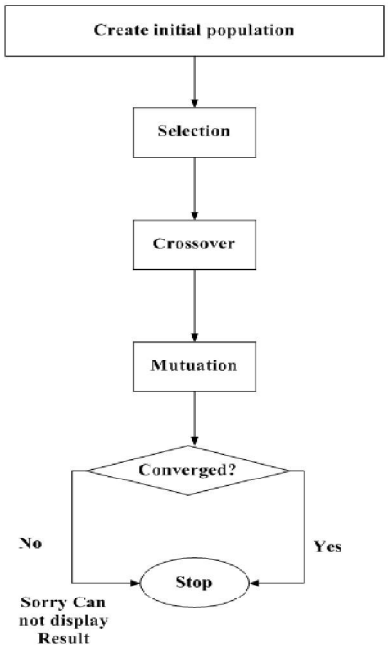

Fig.2. Flow Chart of Genetic Algorithm

Figure 2 shows the Flow Chart of Genetic Algorithm.

Algorithm for ELD using GA

1. Read data namely coefficients a_i,b_i,c_i , population size, power demand and P_{min} and P_{max}.
2. Create the initial population randomly size of N.
3. Check the constraints, evaluate fitness function and store the total cost of generation and related variables.
4. Apply Genetic Operators.
5. Check Converse, if abs(conv)>gap then GA cannot find solution. if abs(conv)<gap then Genetic Algorithm will give solution.

V. RESULT AND DISCUSSION

The Economic Load Dispatch problem was solved using Lambda Iteration Method and Genetic Algorithm. The programs are implemented in MATLAB 7.12.0. The performance is evaluated without considering losses using 3 generator and 6 generator test system. The power demand is considered to be 850MW and 1260MW respectively. The coefficients of fuel cost and maximum and minimum power limits are given in Table I and Table II respectively. Table III shows the comparing results of Lambda Iteration Method and Genetic Algorithm for 3 generators. Table IV shows the comparing results of Lambda Iteration Method and Genetic Algorithm for 6 generators.

TABLE I. FUEL COST COEFFICIENTS FOR 3 GENERATOR SYSTEM

Unit No.	a_i	b_i	c_i	P_i min (MW)	P_i max (MW)
1	0.001562	7.92	561	150	600
2	0.00194	7.85	310	100	400
3	0.00482	7.97	78	50	200

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TABLE II. FUEL COST COEFFICIENTS FOR 6 GENERATOR SYSTEM

TABLE III.

Generator No.	a_i	b_i	c_i	P_i min (MW)	P_i max (MW)
1	0.0070	7.0	240	100	500
2	0.0095	10.0	200	50	200
3	0.0090	8.5	220	80	300
4	0.0090	11.0	200	50	150
5	0.0080	10.5	220	50	200
6	0.0075	12.0	190	50	120

TABLE IV. COMPARISON OF LAMBDA ITERATION METHOD AND GENETIC ALGORITHM FOR 3 GENERATORS

Generator No.	Generation P (MW)		Fuel Cost F(Rs./hr)	
	Using Lambda Iteration Method	Using Genetic Algorithm	Using Lambda Iteration Method	Using Genetic Algorithm
1	300.00	394.2443	3074.00	3926.1946
2	295.00	342.8098	2795.00	3229.043
3	254.00	112.9449	2419.00	1039.6571
Total	**849.00**	**849.999**	**8288.00**	**8194.8947**

TABLE V. COMPARISON OF LAMBDA ITERATION METHOD AND GENETIC ALGORITHM FOR 6 GENERATORS

Generator No.	Generation P (MW)		Fuel Cost F(Rs./hr)	
	Using Lambda Iteration Method	Using Genetic Algorithm	Using Lambda Iteration Method	Using Genetic Algorithm
1	260.00	445.814	2529.00	4751.9484
2	200.00	170.3327	2579.00	2178.9521
3	221.00	263.8572	2539.00	3089.3712
4	191.00	123.912	2631.00	1701.2194
5	201.00	169.2272	2655.00	2225.988
6	186.00	86.8563	2687.00	1288.8551
Total	**1259.00**	**1259.9992**	**15620.00**	**15236.3342**

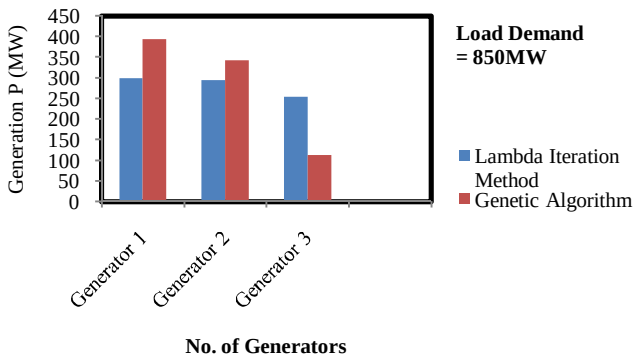

FIG.3 COMPARISON OF TOTAL GENERATION FOR 3 GENERATORS

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FIGURE 3 SHOWS THE COMPARISON OF TOTAL GENERATION FOR 3 GENERATORS.

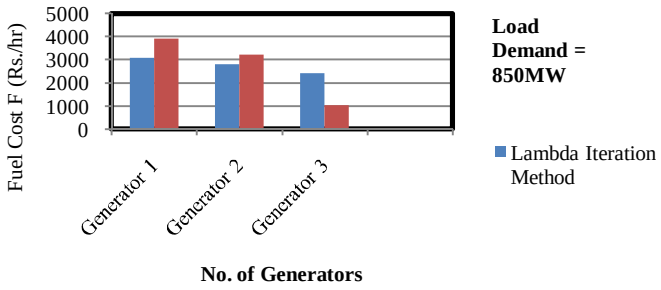

Fig.4 Comparison of total fuel cost for 3 generators

FIGURE 4 SHOWS THE COMPARISON OF TOTAL FUEL COST FOR 3 GENERATORS.

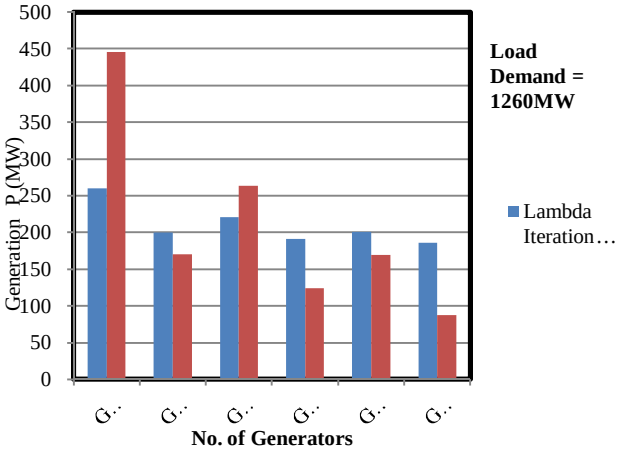

Fig.5 Comparison of total generation for 6 generators

Figure 5 shows the comparison of total generation for 6 generators.

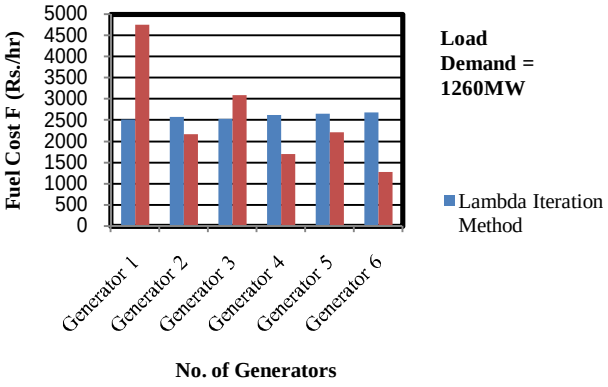

Fig.6 Comparison of total fuel cost for 6 generators

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Figure 6 shows the comparison of total fuel cost for 6 generators.

VI.CONCLUSION

In this paper Lambda Iteration Method and Genetic Algorithm are applied to solve ELD problem. From the results it is clear that Genetic Algorithm gives the better results then Lambda Iteration Method.

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