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Reduce Power Generation Cost by Using Load Dispatch Schedule

KEYWORDS: Optimal dispatch, load distribution and generation

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ABSTRACT *In real practical power systems, power plants are not at the same distance from the centre of load and their fuel costs are different. Also, under normal operating condition the generation capacity is more than the total load demand and losses. Optimal dispatch (OD) is the one main option for scheduling generation that to find an effective real and reactive power scheduling to power plants to meet load demand as well as to minimize the operating cost. This cost function presents economic cost, system security and others. In this research, analyses are limited to the economic dispatch of real power generation. This economic dispatch analysis has been iteratively studied by researchers using different methods and techniques. However this analysis is very difficult, and is much time consuming through manual calculations. The existence of this OD power generation software package helps the consumer to analyze easily in terms of cumbersome unnecessary calculations. This user friendly software package is a good medium for researcher to obtain OD of power generation without really much effort on manual calculation.*

I. Introduction

The purpose of this research paper is to provide the review of previous Economic load dispatch methods published in many journal from various references. The prime objective of the Economic Load Dispatch (ELD) problem is to minimize the total generation cost in power system (with an aim to deliver power to the end user at minimal cost) for a given load demand with due regard to the system equality and inequality constraints. To date, various investigations on ELD problems have been undertaken as better solutions would result in more saving in the operating cost. Many mathematical optimization techniques that are reliable, such as nonlinear programming and dynamic programming have been employed to solve the ELD problems. But due to the non-differential and non-convex characteristics of the cost functions, these methods are also unable to locate the global optima. Among the artificial intelligence methods, Hopfield neural networks have been applied to solve the non- linear ELD problems, but these methods suffer from excessive numerical iterations, resulting in huge computations. Complex constrained ELD problems have been solved by many population-based optimization techniques in recent years. MATLAB[3] programming stands for Matrix Laboratory is easy ways high performances language used to compute the data from this ELD project Besides that some comparison of Economic Load Dispatch method have been used such as Analytical Method, Graphical Demonstration and Gradient Method use in this project to determine Economic Load Dispatch (ELD) problem[2].

The efficient and optimum economic operation and planning of electric power generation systems have always occupied an important position in the electric power industry. In the power system, transmission networks are interconnected through tie lines. Hence the utilities may interchange power, share reserve and render assistance to one another at the time of need. Since the sources of energy are so diverse, so the choice of the required sources is made on economic, technical and geographical basis. As there are few facilities to store electrical energy, the net production of a utility must clearly track its total load. Power economic dispatch is the method how to arrange power to load demand. Load in every hour for example is vary due to usage of electricity, if load at every hour is vary or keep changing therefore load demand in every month is vary. The most cheap power plant or generator will run first to meet demand, and the most expensive power plant or generator will operate if the first generator cannot accommodate the power [1].

II. PROBLEM FORMULATION

In economic dispatch systems where there are more than 2-generating units, two pieces of data will be available for us to work with. They are total load and IC curves of each unit

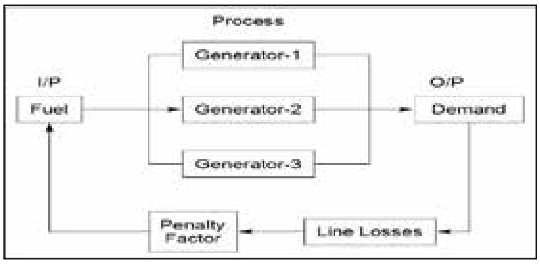

Figure.1 Three Generation system

Three Generator Economic Dispatch Application (TGEDA) using Lagrange Method & Matlab Code approach is carried out by using an iterative procedure that allows us to

(1) Pick an initial value for Lambda
(2) Find the corresponding output power each generating unit.
(3) Check if output power is less required load [2].

Economic dispatch neglecting losses and no generator limit:

The simplest economic dispatch problem is the case when transmission line losses are neglected. That is, the problem model does not consider system configuration and line impedances. In essence, the model assumes that the system is only one bus with all generation and loads connected to it as shown schematically in figure.2.

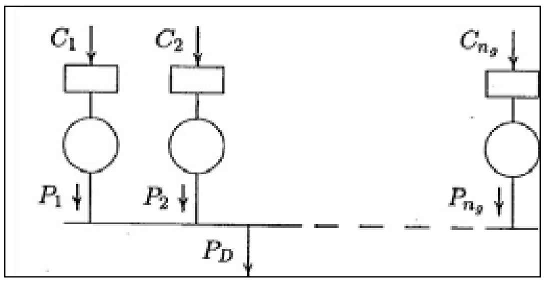

Figure.2 Generator bus

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Since transmission losses are neglected, the total demand PD is the sum of all generation. A cost function Ci is assumed to be known for each plant. The problem is to find the real power generation for each plant such that the objective function as defined mathematically in (1).

$$C_t = \sum_{i=1}^{n_g} C_i = \sum_{i=1}^{n} \alpha_i + \beta_i P_i + \gamma_i P_i^2$$

Eq..(1)
Where Ct=total cost, i= no of generation, Pi=generation
α, β, γ are constant of power plant.

Economic dispatch neglecting losses and including generator limits
The power output of any generator should not exceed its rating nor should it be below that necessary for stable boiler operation. Thus, the generations are restricted to lie within given minimum and maximum limits. The problem is to find the real power generation for each plant such that the objective function as defined is minimum, subject to the constraint given and the inequality constraints given by (2).

$$P_{i(min)} \leq P_i \leq P_{i(max)} \qquad i = 1, \ldots, n_g$$

Eq…(2)
where min and max is generator limit

Economic dispatch including losses
When transmission distances are very small and load density is very high, transmission losses may be neglected and optimal dispatch of generation is achieved with all plants operating at equal incremental production cost. However, in a large interconnected network where power is transmitted over long distances with low load density areas, transmission losses are a major factor and affect the optimum dispatch of generation. One common practice for including the effect of transmission losses is to express the total transmission loss as a quadratic function of the generator power outputs. The simple quadratic form is expressed in (3)[4].

$$P_L = \sum_{i=1}^{n_g} \sum_{j=1}^{n_g} P_i B_{ij} P_j$$

Eq..(3)

III. TEST PROBLEM
The economic load dispatch (ELD) problem was solved using the differential evolution algorithm. The simulation was performed on the Np generators test system The parameters used for the different system are decided as per their technical specification and their limits. And on the base of this we get the output for the Economic load dispatch problem. We arrange Matlab programming for the calculation of the above system and try to evaluate whole system. Now we develop Flowchart and Algorithms for the programming of our system and calculation. From this flowchart and Algorithms we develop Matlab base programming [5].

Gen data
[0.006085 10.04025 136.9125 5.0 150.0; 0.005915 9.760576 59.1550 15.0 100.0; 0.005250 8.662500 328.125 50.0 250.0]

B coefficient
[0.0001363 0.0000175 0.0001839; 0.0000175 0.00001545 0.0002828; 0.0001839 0.0002828 0.0016147]

IV. ALGORITHM
Algorithms for the evolutionary technique for economic load dispatch is as per given below. From this algorithm we can develop flow chart and then Matlab program for economic load dispatch [5].

Step.1 Input the number of generator and their rating with maximum and minimum limit of working.

Step.2 Convert decimal string in to binary string for the all generator.

Step.3 Enter the loss coefficient of the generator.

Step.4 Initial population of generation means select the random value for the generation within their limit and constraint checking for the generator limit.

Step.5 Find the losses for each combination of randomly selected generators.

Step.6 Find the total generation requirement of load with their losses and select population for the next calculation in our case no of population selected is 20.

Step.7 Now select the total generation for the above population

Step.8 Enter the cost matrices and calculate the cost function of the each population. Find the fitness function for the each population.

Step.9 Find the total cost function and arrange them in to ascending order.

Step.10 Now Proliferation of population based on fitness means develop more population for the further calculation from the above ascending order in such away that more number for the first answer. In our case we generate 30 numbers from the above population.

Step.11 Hyper Mutation with rate proposal to fitness, Change the value of above population and verify the generator limit for the each generator.

Step.12 Now calculate losses for the above new value of the generator. And find the new total generation with loss of the system and develop new generation.

Step.13 Calculate the total deviation from the loss and find the penalty factor.

Step.14 Calculation of total cost function for the above generator rating.

Step.15 Find the final fitness function with penalty function.

Step.16 Tournament selection is done to select same number of mutated clones as there are in initial population. This completes one cycle of the selection.

Step.17 The above process is repeat as per number of iteration entered by us during starting of the program.

Step.18 Generate the graph between iteration and total cost function and final fitness function.

Step.19 Stop

V. RESULT ANALYSIS
Load: - 100MW
Enter the value of load demand in MW: 100
Solution has converged in 11 iterations
The value of Pg1 = 18.095747
The value of Pg2 = 37.422144
The value of Pg3 = 50.000000

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The cost of generation is 1527.666038 Rs/hr
Transmission losses are 5.517801 MW
Load: - 200MW
Enter the value of load demand in MW: 200
Solution has converged in 47 iterations
The value of Pg1 = 42.186962
The value of Pg2 = 15.000000
The value of Pg3 = 250.000000
The cost of generation is 3600.079375 Rs/hr
Transmission losses are 107.187042 MW
Load: - 250MW
Enter the value of load demand in MW: 250
Solution has converged in 44 iterations
The value of Pg1 = 16.861335
The value of Pg2 = 100.000000
The value of Pg3 = 250.000000
The cost of generation is 4224.172115 Rs/hr
Transmission losses are 116.861414 MW
Load: - 300MW
Enter the value of load demand in MW: 300
Solution has converged in 48 iterations
The value of Pg1 = 72.895264
The value of Pg2 = 100.000000
The value of Pg3 = 250.000000
The cost of generation is 4817.370752 Rs/hr
Transmission losses are 122.895361 MW
Load: - 350MW
Enter the value of load demand in MW: 350
Solution has converged in 53 iterations
The value of Pg1 = 129.913863
The value of Pg2 = 100.000000
The value of Pg3 = 250.000000
The cost of generation is 5460.218035 Rs/hr
Transmission losses are 129.913945 MW

Table:-1 Generation and cost

Load in MW	P1	P2	P3	loss	Total gen.	Gen. cost
100	18	37	50	5	105	1527
200	42	15	250	107	307	3600
250	16	100	250	116	366	4224
300	72	100	250	122	422	4817
350	129	100	250	129	479	5460

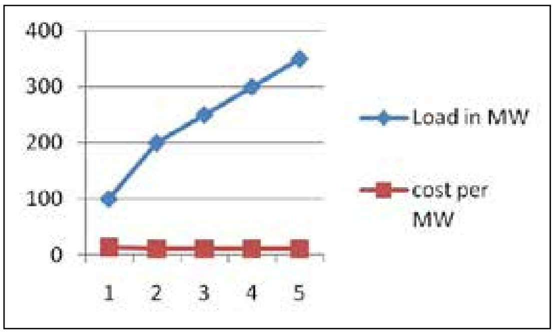

Figure.3 Generation and cost

VI. CONCLUSION

We calculate the cost of generation for the different load condition and find optimum load dispatch for above power plant which is used fully to reduce the overall cost of power generation. By using the MATLAB program we have prepared, utility can supply different load at different time in a most economical way. We can reduce the overall of generation by using other optimization technique.

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