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Emission Reduction Technique from Thermal Power Plant By Load Dispatch

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Abstract - Reduction in the emission of the SO2 gases from power system operation is the very giant task of pollution control system. There are so many methods are used for the reduction of the SO2 emission from the power plant. All the methods require so many equipment and additional arrangement for the reduction in SO2 emission from the power plant. On the other hand if we reduce the emission with arraigning load in proper schedule than there are no additional arrangement and equipment require. In this method we can use the optimum output in terms of emission from the different power plant. Overall emissions reduce for the given output of power with same equipment by load dispatch scheduling.

Keywords - Emission constraint, Scheduling, Load dispatch.

I. INTRODUCTION

Power generation system is the mirror for any developing country. Any development in country is directly related with the development in the power system generation and increase in the power plant. There are different types of power plants are used for the electrical power generation. In India major part of total electrical power generation is form the thermal power plant. Now with the development number of power plant must be increased to fulfil the requirement of load. But due to this increase so many problems arise. Major problem is the pollution from the power plant. In thermal power plant there are so many factors related with the pollution. Greenhouse gases emission from the thermal power plants takes main part in air pollution. SO2 gas creates major effect on the environment among the all flue gases generated from the thermal power plant. So reduction in the amount of SO2 emission from the thermal power plant is the major task for the pollution control board and authority with the same electrical power generation. Now there are many filter and accessories are used from the reduction in the SO2 emission from the thermal power plant. All these arrangements require additional equipment so overall cost is also increased with this additional modification. Now in advance management system emission can be reduce by the proper load arrangement among the all power thermal power plant units which are connected in the same grid. In this paper this load dispatch used for the reduction of SO2 gas emission from the thermal power plant.

II. PROBLEM FORMULATION

A three-generator system has been considered for the load dispatch for the reduction in SO2 emission. General equation for the emission calculation for the individual power plant unit is as per given below.

$$F_1 = \sum_{i=1}^{NG} \left(a_i Pg_i^{\,2} + b_i Pg_i + c_i \right) \qquad \text{Kg. /h}$$

Where ai, bi and ci are SO2 coefficients and NG is the number of generators and F1 is total SO2 emission from the each thermal power unit. Our requirement is to minimize the value for the F1 for the each plant at given. At different value of load generating output of plant may be differing but the

overall value for the F1 must be minimal. So our problem is to minimize the value of F1 with load. For the above there are so many methods has been used.

III. METHODOLOGY

Different method for the minimization of emission is as used with different computerised model. Here we use Evolutionary Method. Evolutionary Programming has been used in the field of design search and optimization more thoroughly after the exposure. There are a quite number of data that has shown the implementation of economic dispatch using classical Evolutionary Programming. Mainly, the interest of using classical Evolutionary Programming as the method for the economic dispatch problem is because of its simplicity to GA where Evolutionary Programming does not involve any special coding. Real number valued is used in the process. Secondly, Evolutionary Programming does not impose any alteration of the objective function or constraints restriction. Hence, the transfer of the problem into algorithm is fairly simplified. For the purposes of this study, types of Evolutionary Programming to be used are as per given.

3.1 General Evolutionary Programming

This program used for standard calculation and mutation. Normal Distribution is used in General Evolutionary Programming method. Selection of Mutation is on the base of random population. In GEP for the generation of offspring Gaussian or normalized random variables are undertaken (Rambabu, et al. 2011).
For local optimal solution GEP performs better as it takes mall steps to find the global optimum solution if it lies within the local neighborhood region. Due to its limitation of searching global solution in the local neighborhood region, it has a slow convergence rate to the optimal solution if it lies far from the local search area. It can also be implemented into some unimodal functions and multimodal functions with some local minima as it provides fine tuning to find the global optimum solution.

3.2 Fast Evolutionary Programming

Evolutionary programming technique using Cauchy mutation operator for the mutation or the generation of offspring is termed as FEP. Fast evolutionary programming performs more efficiently and relative have more strength to find the optimal solution. As the step size of FEP is larger, simple and straightforward to find a global optimal solution (Rajsomshekhar, et al. 2009).
So it performs more efficiently and faster to find the globally optimal solution to multimodal optimization problems. Since its step size is large to find the globally optimal solution, but it is only effective at the start of evolution to find a solution as the global optimal solution lies far away from starting search point. As the evolution proceeds for the solution, it becomes slow or there may also be chance of selecting a less optimal solution as the global solution lies very near in the searching area (Ling, et al. 2011). Figure 3 depicts that Cauchy mutation operator generates offspring further away from main population or parents as compared to Gaussian mutation operator due to its long flat tails.
So Cauchy mutation has more probability of escaping from local optimum and moreover a smaller hill around the center indicates that Cauchy mutation spends less time in exploiting the local neighborhood and thus has, the weaker fine tuning ability as compared to Gaussian mutation operator in small to mid range regions.

3.3 Selective Evolutionary Programming

As position of the global optimum solution is unknown, making a choice between a selection of Cauchy and Gaussian mutation operator. So instead of switching from Gaussian to Cauchy mutation

operator, the idea is to mix different search basis Cauchy and Gaussian mutations.
In SEP generate two offspring one from Gaussian mutation operator and one from Cauchy mutation operator. Therefore population size of SEP is half than that required in GEP and FEP. The Selective Evolutionary Programming uses both types of distribution in its mutation. Moreover SEP is robust and does not require no prior knowledge of the problem to be solved.

Table:-1 Generator Data

No. of Generator	Generator rating in Mw.	Maximum Value in Mw.	Minimum Value in Mw.
1	210	240	90
2	210	238	85
3	120	100	20

Computerized program developed for the above methods with Mat lab language. Data for the generator is as per the given below. Here we consider three units for the calculation and their maximum and minimum capacity is as per table. SO2 emission coefficient for the each three plants are as per given in table

Table:-2 SO2 emission coefficient

Sr.No.	ai	bi	ci
1	0.001206	5.05928	51.3778
2	0.002320	3.84624	182.2605
3	0.001284	4.45647	508.5207

Loss coefficient of plant is as per given in table

Table:-3 Loss coefficient

Sr.No.	di	fi	gi
1	0.000134	0.0000176	0.000183
2	0.0000176	0.000153	0.000282
3	0.000183	0.000282	0.00162

IV. RESULT

From running program with above data total emission for SO_2 can be produce. Collect total output of emission for all method which is to be studied. From the above procedure we get SO_2 emission for different value of generation with different methodology for the comparison. Comparison of all method at different loading condition of plant is as per given in table 4. Colum no.2 indicate total load on the power generating unit. Colum no. 3 indicates Emission of SO_2 with evolutionary technique. Colum no. 4 indicates Emission of SO_2 with Genetic technique. Colum no. 5 indicates Emission of SO_2 with Weighted method. Colum no. 6 indicates Emission of SO_2 with Classical technique.

Table:-4 Result with all method

Sr.No.	Load MW	Emission by Evolutionary Method (Kg./Hr.)	Emission by Genetic Method (Kg./Hr.)	Emission by Weighted Method (Kg./Hr.)	Emission by Classical Method (Kg./Hr.)
1	300	2166	2317	2263	2408
2	350	2433	2528	2829	2585
3	400	2678	2790	2801	2812
4	450	2931	3034	3084	3285

Comparison graph of above all method is as per shown in fig.1

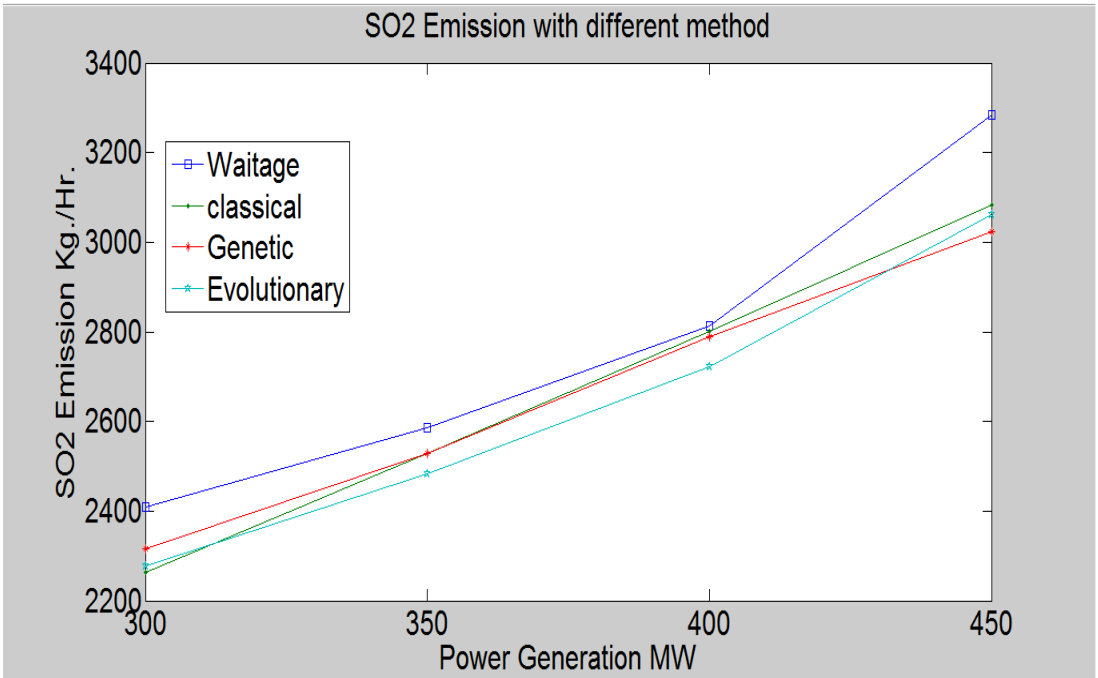

Fig. 1 SO_2 Emission for all method

V. CONCLUSION

Result shows that Emission is low with the help of Evolutionary technique. In all method total output is never change but the emission of SO2 gas is reduced with the proper selection of their generating station. Best result shows the lesser emission of SO2 gas form the generating unit at same load. This will reduce the overall generation of SO2 gas for the Power system.

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