PARTICLE SWARM OPTIMIZATION BASED NEURAL NETWORK APPROACH FOR SOLVING ECONOMIC DISPATCH PROBLEM IN POWER SYSTEM

R. LEENA ROSE, R. LAL RAJA SINGH, S. PRABHAKAR KARTHIKEYAN, E. UDAYAKUMAR

ABSTRACT

The electric power framework comprises of the producing element's distribution with least fuel price and furthermore thinks about the transmission vitality. Model Predictive Control (MPC) approach proposed as of late to the dynamic dispatch issues is high all in all limitations transmission vitality misfortune. It is the principle issue because of the wastefulness and significant expense. To tackle this issue here, expected to propose a mixture method to enhance the financial dispatch issue in control framework. The Particle Swarm Optimization (PSO) and Neural Network (NN) half and half strategy will be utilized to limit the cost capacity of producing units and adjusting the absolute burden request with the abatement in transmission vitality misfortune. PSO is one of the computational procedures that acquire an ideal burden planning arrangement and neural system will be utilized to give compelling result dependent on load request. At first all the creating force will be acquired from the producing units. At that point, a power esteem is arbitrarily browsed the acquired power. The condition for picking subjective producing power esteem is to fulfill the heap request of the dissemination framework. At that point, utilizing PSO calculation the producing force will be enhanced for the given burden request and creating cost. Subsequent to performing PSO, the neural system preparing technique will be utilized to prepare all the producing power concerning the heap interest for controlling the NOx and SO2 emanations. Since, the heap request worth will be changed relying upon the estimation of burden variety. The financial dispatch issue will be understood by the enhanced creating power and anticipated burden request. The proposed crossover system will be actualized in MATLAB stage and its exhibition will be assessed dependent on fuel cost, vitality misfortune rate and outflow control.

Keywords: Economic Dispatch, Particle Swarm Optimization (PSO), Neural Network (NN), Load Demand, Hybrid Technique.

I. INTRODUCTION

Thermal power generation consume the petroleum derivatives and produce lethal gases in their emanating and these become a wellspring of contamination for the earth. The monetary power dispatch issue with release of harmful gases is investigated. The audit of flow look into works in financial dispatch issues has indicated that they take care of the issue by using various sorts of enhancement methods. In a fixed range they have overhauled the generator yield control in this way the essential systems of progress methodology are not flexible for assortments of generator control. So the foreseen generator yield power will be questionable.

The yield of the streamlining strategies relies upon the quantity of age units. Agreeable yield may not be acquired and the wellness of the yield control additionally gets influenced, if the quantities of age units are expanded. In the produced power the influenced yield prompts control quality issues. The power quality issue influences genuine power esteem that prompts changes in control factor. These all variables increment the power creating cost. Outflow cost is another most significant parameter. It is considered as the framework influences the earth more, if the emanation cost is high.

In a portion of the streamlining strategy setting the underlying worth is troublesome, since the underlying worth has been picked aimlessly. In this way, the iterative procedures gets intricate and the last arrangement requires to be approximated. The issue is treated here as a multi-target model and the cross breed procedure means to tackle the issue. A.M. Elaiwa,c., et.Al., 2012 MPC approach tackles the dynamic dispatch issues in both controlled and deregulated frameworks. The combination and power of the MPC calculations are shown through the utilization of
MPC to these issues with a six-unit framework however transmission line misfortunes in non-arched capacities and transmission vitality misfortune is high even when all is said in done limitations.

The fundamental commitment in investigate work is to work a power framework in such a manner to supply every one of the heaps at the base fuel cost of age and controlling the natural contamination brought about by emanation of harmful gases of fossil based warm creating units. An able and reliable arrangement which is applied for least cost and least NOx discharge is molecule swarm enhancement (PSO) strategy. In electric power framework activity, the goal is to achieve the most efficient age approach that gives the heap requests without abusing limitations.

The majority of intensity framework improvement issues including financial burden dispatch have composite and nonlinear qualities with enormous equity and imbalance imperatives. The PSO is the most phenomenal procedure to take care of enhancement load request issues with less computational time for different number of cycle. The molecule swarm advancement computational proficiency is higher and every up-and-comer in PSO with arbitraries speed moves in an answer space. The PSO is called most brilliant arrangement system for load booking on account of less computational time, strong, quick for tackling multi ideal issues and furthermore to take care of non-curved streamlining issues.

Neural systems have been utilized for taking care of the monetary dispatch issue and have been generally applied to control frameworks for acquiring the productive result with control in Nitrogen oxide (NOx) and Sulfur di-oxide (SO2) outflows. The cross breed method use in a power framework decide the most ideal mix of intensity yields for all creating units which diminish the absolute fuel cost and fulfill load and operational imperatives.

The remainder of the paper is sorted out as pursues. Area 2 portrays about the various overviews with their impediments. Segment 3 subtleties the PSO utilized in control framework to plan the heap and neural system preparing technique gives a lesser vitality misfortune while transmission with outflow control. Area 4 gives the exploratory outcomes a change to fulfill the heap request with emanation control. Area 5 assessed the outcomes and examine quantitatively. The last segment abridges a helpful arrangement of monetary dispatch issue against the MPC approach.

II. LITREATURE REVIEW

The financial dispatch enhancement issue is one of the essential issues in control frameworks so as to get hold of steady, trustworthy and secure advantages. A power framework comprises of segments like generator, lines, transformers, burdens, switches and compensators [3]. The four uncommon developmental calculations to be specific hereditary calculation, microscopic organisms searching improvement, subterranean insect province streamlining and molecule swarm enhancement clarify the monetary dispatch multifaceted nature to gauge the adequacy of every strategy [14].

Mimicked Annealing (SA) calculation for improvement [2] invigorated the way toward tempering in thermodynamics to fathom Economic Load Dispatch (ELD) issues. It furnishes ideal outcomes while working with working imperatives in the ELD yet dangerous gases are transmitted in higher proportion. Hereditary calculation (GA) with Active Power Optimization (APO) half breed approach takes care of the ED issue [6] by utilizing the valve-point impact. The hereditary calculation goes about as an all-inclusive streamlining agent giving close to most good age program, which turns into the contribution for age transports in APO calculation.

Half and half method SQP utilizes GA [8] as the fundamental enhancer to adjust the arrangement. In light of the most extreme entropy standard, the cost capacity of EDP is approximated by utilizing a smooth and differentiable capacity. Differential Evolution (DE) calculation is resolved [9] to illuminate Emission Constrained Economic Power Dispatch (ECEPD) issue however the vitality misfortune rate is high.


Improved Coordinated Aggregation based Particle Swarm Optimization (ICA-PSO) calculation [5] is presented for settling the ideal financial burden dispatch (ELD) issue in control frameworks however bombs in stochastic
emanation control. Multi-target model for financial dispatch (ED) is proposed to fathom the disparity requirements and to confine the stochastic CO2, SO2 and NOx discharges [22].

Molecule Swarm Optimization (PSO) technique is created to concurrence with the monetary burden dispatch [7] while simultaneously thinks about the environmental effect however bombs in dependability obliged dispatch structure. Molecule Swarm Optimization (PSO) procedure with Anti-Predatory molecule Swarm Optimization (APSO) take care of non-curved monetary dispatch issues [11]. Adjusted molecule swarm improvement comprises of issue subordinate variable number [18] of promising qualities, unit vector and flaw cycle dependent advance length.

Increased Lagrange Hopfield arrange (ALHN) take care of ED issue [12] with incline rate, outflow and transmission limitations. The vitality work dependent on enlarged Lagrangian work, the ALHN strategy has been a ceaseless hopfield neural system. Differential Evolution (DE) calculation was read for settling financial burden dispatch (ELD) issues [17] in control frameworks for unraveling numerous true obliged streamlining issues in various non-direct spaces.

Adjusted Group Search Optimizer (MGSO) is displayed for improving the scrounger and officer administrators of GSO [13]. A systematic technique dependent on numerical displaying illuminates monetary, discharge, and joined financial and outflow dispatch issues [15] just through single proportional target work. Enhancement calculation dependent on idea of co-advancement and fix calculation for taking care of non-straight requirements is introduced in [16]. A point by point monetary translation of the outcomes is accommodated hold compelled financial dispatch [20]. The advancement of norms based power framework interchanges taking care of the issues of expanded power requests, control advertise deregulation and power frameworks dependability, at that point plans for multi-merchant condition of the shrewd matrix [21].

Dynamic Economic Dispatch (DED) issue utilizing a half and half method of Hopfield Neural Network (HNN) and quadratic programming (QP) [19] guarantee the worldwide optimality of the arrangement. In writing, however not very many works have endeavored to yield care of the monetary report issue by considering producing cost and outflow cost utilizing cross breed enhancement systems; they are ineffectual in taking care of this issue. All the above issues and downsides propelled us to do investigate chip away at financial dispatch issue.

### III. PROBLEM FORMULATION

In control age framework, financial and discharge dispatched issues are the two essential however various issues to be basically considered. The monetary dispatch issue in MPC targets just limiting the complete fuel cost of the framework with viable burden booking, it might damage as far as possible. The outflow dispatched issue in [1] targets just limiting the discharge from the framework; it might disregard as far as possible. These assessments are utilized to decide the ideal blends i.e., unit responsibility of the creating power, which is exposed to decrease the complete fuel cost with emanation control. Along these lines, it is important to decide the cost components and transmission vitality misfortune issue utilizing the PSO and NN mixture procedure.

#### 3.1 Problem formulation for load scheduling using PSO

PSO is an optimization technique with $l_{best}$ population of arbitrary answer space. The $l_{best}$ is the position best for load preparation and it is defined as the best earlier location giving the best strength value of the $i$th particle but not in a group of particles. The $s_{best}$ is defined as best optimization solution in a swarm and some significant key language related to PSO are defined as:

The velocity of the particle in PSO for load scheduling in power system is changed according to following equation:

$$v_n = \omega v_n + d_1 \text{arbit}_1 \times (l_{best} - y_n) + d_2 \text{arbit}_2 \times (s_{best} - y_n)$$

Where, $v_n$ = Particle velocity in the $n$th dimensional search space $y_n$ = Particle coordinates in $n$th dimensional search space $\omega$ = Inertia weight $d_1$and $d_2$=Two positive acceleration constants $\text{arbit}_1$and $\text{arbit}_2$=the arbitrary number functions between 0.0 to 1.0. The new coordinate for load scheduling in power system is computed for each dimension by following equation

$$y_n = y_n + \Delta t \times v_n$$
The commitment work with PSO utilizes d1 and d2 for emphasis and the weight shifting directly over the run time in control age for booking the heap. The principle goal of PSO in control framework is minimization of fuel cost with compelling burden adjusting. The age of the units fulfills the absolute need and vitality misfortunes of the influence framework. The correspondence imperative is given by

\[
\begin{bmatrix}
S_1 \\
S_2 \\
\vdots \\
S_n
\end{bmatrix} =
\begin{bmatrix}
P_{G1} + jQ_{G1} \\
P_{G2} + jQ_{G2} \\
\vdots \\
P_{GN} + jQ_{GN}
\end{bmatrix} =
\begin{bmatrix}
P_{D1} + jQ_{D1} \\
P_{D2} + jQ_{D2} \\
\vdots \\
P_{DN} + jQ_{DN}
\end{bmatrix}
\]

Where \(P_{G1}, P_{G2}, \ldots P_{GN}\) and \(Q_{G1}, Q_{G2}, \ldots Q_{GN}\) is the actual and reactive power generated in the 1, 2, \ldots \(N_G\) units, \(P_{D1}, P_{D2}, \ldots P_{DN}\) and \(Q_{D1}, Q_{D2}, \ldots Q_{DN}\) is the active and reactive power demand in the 1, 2, \ldots \(N_B\) buses, \(P_{L1}, P_{L2}, \ldots P_{LN}\) and \(Q_{L1}, Q_{L2}, \ldots Q_{LN}\) is the actual and reactive power losses in the 1, 2, \ldots \(N_B\) buses. Each generating unit is operated by its active and reactive power output limits, which provide the stable working condition and satisfy load demand.

The inequality actual and reactive power constraints are given and the power inequalities are specified in the equation (4) with optimization of objective functions.

\[
P_{Gj}^{\text{max}} \leq P_{Gj} \leq P_{Gj}^{\text{min}} ; \quad i = 1, 2, \ldots N_G
\]

\[
Q_{Gj}^{\text{max}} \leq Q_{Gj} \leq Q_{Gj}^{\text{min}} ; \quad i = 1, 2, \ldots N_G
\]

(4)

(5)

The significant advances utilized in the Particle Swarm Optimization Technique for the arrangement of powerful burden planning:

1: Describes the arrangement space and power esteem.

2: Initialize Swarm speed and area.

3: Find the lbest and sbest arrangement and update the molecule speed and position.

4: Repeat the procedure to fulfill load request dependent on lbest.

The above calculation depicts single individual (honey bees) in a created unit space with the individual lbest area of a molecule. The gbest is the specific area of a swarm molecule (for example load dispatch) for the whole financial burden booking units. The greatest speed of a provided power created guidance is meant in Vmax. The molecule ‘area’ is the n-dimensional arranges in control framework. Swarm is whole territory secured by the power framework for monetary power dispatch. The vigor is the estimation of produced control in framework to fulfill the interest.

**3.2 NN Problem formulation for energy loss and emission control**

The NO\(_x\) and SO\(_2\) emission control using the neutral network training method initially optimize the NO\(_x\) emission with load balance constraint and on similar lines SO\(_2\) emissions are also optimized. For performing the NO\(_x\), the objective function \(E_{qT}\) is to be minimized.

\[
E_{qT} = \sum_{i=1}^{N_G} e_i Q_i
\]

Subjected to
∑ \( P_i \) = \( P_{DN} + P_{LN} \)
\( P_{i}^{\text{min}} \leq P_i \leq P_{i}^{\text{max}} \)

Where, \( E_{uq} \) is the total NO\(_x\) emission in the generated power units, \( e_{iq} \) is the NO\(_x\) emission of the generator, \( P_{DN} \) is the load demand, \( P_{LN} \) total system transmission energy loss, \( P_i \) is transmission of \( i^{th} \) plant power, \( P_{i}^{\text{min}} \) and \( P_{i}^{\text{max}} \) are the minimum and maximum generating limits respectively for plant ‘\( i \)’.

SO\(_2\) emission control using objective function \( E_{ut} \) minimizes the output result control.

\[ E_{ut} = \sum_{i=1}^{QG} e_{iU} \]  \hspace{1cm} (7)

Subjected to

\[ \sum_{i=1}^{QG} \]  \hspace{1cm} (7)

\[ \sum_{i=1}^{QG} P_i = P_{DN} + P_{LN} \]
\[ P_{i}^{\text{min}} \leq P_i \leq P_{i}^{\text{max}} \]

Where, \( E_{ut} \) is the total SO\(_2\) emission in the generated power units, \( e_{iU} \) is the SO\(_2\) emission of the generator, \( P_{DN} \) is the load demand, \( P_{LN} \) total system transmission energy loss, \( P_i \) is transmission of \( i^{th} \) plant power, \( P_{i}^{\text{min}} \) and \( P_{i}^{\text{max}} \) are the minimum and maximum generating limits respectively for plant ‘\( i \)’ to remove SO\(_2\) emission. The NO\(_x\) and SO\(_2\) emission controlled using the neural network training method and effective outcome produced in power system after the load demand satisfied.

The processed power are scheduled and distributed depending on the user needs. While transmitting the power the energy loss may occur depending on the power transmission capacity. The transmission energy loss of the power system is calculated by the following equations (8) and (9).

\[ P_L = \sum_{i=1}^{QG} \sum_{j=1}^{QG} \left[ A_{ij}(P_i + Q_{ij}) + B_{ij}(Q_i - P_{ij}) \right] \]  \hspace{1cm} (8)
\[ Q_L = \sum_{i=1}^{QG} \sum_{j=1}^{QG} \left[ C_{ij}(P_i + Q_{ij}) + D_{ij}(Q_i - P_{ij}) \right] \]  \hspace{1cm} (9)

Where,

\[ A_{ij} = \frac{R_{ij}}{\sqrt{V_i V_j}} \cos(\delta_i - \delta_j) \]  and  \[ B_{ij} = \frac{R_{ij}}{\sqrt{V_i V_j}} \sin(\delta_i - \delta_j) \]
\[ C_{ij} = \frac{X_{ij}}{\sqrt{V_i V_j}} \cos(\delta_i - \delta_j) \]  and  \[ D_{ij} = \frac{X_{ij}}{\sqrt{V_i V_j}} \sin(\delta_i - \delta_j) \]

With \( A_{ij}, B_{ij}, C_{ij} \) and \( D_{ij} \) are the loss coefficients, \( \delta_i \) and \( \delta_j \) are load angles at the buses, \( R_{ij} \) and \( X_{ij} \) are the actual and reactive components of the impedance bus matrix. The below fig 3.1 describes the PSO and NN hybrid technique flow diagram for solving the economic dispatch problem.

The Fig. 3.1 initially generates the power in arbitrary position (i.e) random form of request from user for the power units. The load scheduled based on velocity vectors using eqn (2) for the users. For each particle location (l) evaluate robustness value using the PSO, if the robustness (l)>robustness o (lbest) then lbest = l obtained. The load demand scheduled based on the lbest minimizes fuel cost with effective load balancing. Neural network training method controls the NO\(_x\) and SO\(_2\) emission, evaluated through eqn (6) and (7). Energy loss rate while power transmission is also reduced in hybrid technique using the \( A_{ij}, B_{ij}, C_{ij} \) and \( D_{ij} \) loss coefficient computation.
IV. EXPERIMENTAL EVALUATION

The PSO algorithm with NN hybrid technique solves the economic load dispatch problem using Matlab software with high speed. Operation data of seven units NTPS system is used for experimental evaluation. The economic and emission problems are converted into the single problem, i.e., price penalty factor. The price penalty factor consists of both the economic and emission dispatched problems. In this hybrid technique both problems are converted into a single problem known as a price penalty factor. Depending on this factor the rate of the penalty price is fixed. Because of the hybrid technique, it is used to find the penalty price value. It is described in the following,

\[ F = \frac{E_{CT}(P_i^{\text{max}})}{E_{MT}(P_j^{\text{max}})} \]

Where, \( F \) is the price penalty factor, \( i \) is the highest fuel cost unit, \( j \) is the highest pollutant emission unit. In this PSO and NN hybrid work, the combined objective function is described by.

\[ \text{Min } \Phi_T = [w_{EC} * E_{CT} + F * w_{EM} * E_{MT}] \]

Where, \( \Phi_T \) is the combined objective function. \( w_{EC} \) and \( w_{EM} \) are the weighting factors of economic dispatch problem. The two weighting factors are provided in many ways. If classical economic dispatch problem, both weighting factors are \( w_{EC} = 1.0 \) and \( w_{EM} = 0 \). If pure economic dispatch problem, the resulted weighting factors \( w_{EC} = 0 \) and \( w_{EM} = 0.1 \). The economic emission problem, the two weighting factors should be equal. The both weighting factors of the hybrid technique are chosen as \( 0.5 \). The hybrid technique is used to determine the unit commitment of the generating units. The generating power of each unit are determined by the following equation.
\[
1 - \frac{(b_i + F_m \tau_i)}{\lambda_{n,v}} - \sum_{j=1}^{n} 2B_n P_j \\
P_i = \frac{(2a_i + 2F_m a_i)}{\lambda_{n,v}} + 2B_n
\]

Where, \( P_i \) is power generation of the \( i^{th} \) unit, \( \lambda_{n,v} = \lambda_{\text{min}} + \lambda_{\text{Nor}} (\lambda_{\text{max}} - \lambda_{\text{min}}) \) is the actual incremental cost, let \( \lambda_{\text{min}} \) and \( \lambda_{\text{max}} \) minimum and maximum values of system incremental cost, \( \lambda_{\text{Nor}} \) normalized system incremental cost, \( F_m \) is the price penalty factor as shown in above equation, \( a_i, b_i \) and \( \tau_i \) is the fuel cost and emission coefficients. The objective functions are used to find the low cost combinations among the given generating units and satisfying the demand.

The ideal mix of the producing unit is determined with the utilization of the half and half procedure i.e., PSO and NN. The PSO in crossover procedure is utilized to create the self-assertive quantities of producing units, which fulfilling the framework requests with limited target work. The half and half procedure contains another part that is NN that lessens the emanations of the power framework assessments. The cross breed framework NN has been prepared by the ideal mixes of creating units for each request. It requires some investment to the assessments.

V. RESULTS AND DISCUSSION

Particle Swarm Optimization (PSO) and Neural Network (NN) hybrid technique are compared with the existing Model Predictive Control (MPC) approach using the operation data of seven units NTPS system in measuring the fuel cost, emission control and energy loss rate.

The fuel cost is measured based on the (Rs/hr). Swarm size in PSO varies and iterations differ for each time size. The CPU time is measured; result demonstrates that PSO-NN Hybrid technique fuel cost is minimal in non-differential areas when compared with the MPC Approach in regulated systems.

<table>
<thead>
<tr>
<th>Swarm Size</th>
<th>No. of iterations</th>
<th>CPU Time</th>
<th>Cost (Rs/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500</td>
<td>5</td>
<td>0.8876</td>
<td>4950</td>
</tr>
<tr>
<td>1250</td>
<td>7</td>
<td>0.7176</td>
<td>4100</td>
</tr>
<tr>
<td>1000</td>
<td>5</td>
<td>0.6945</td>
<td>3250</td>
</tr>
<tr>
<td>750</td>
<td>8</td>
<td>0.6690</td>
<td>2000</td>
</tr>
<tr>
<td>500</td>
<td>10</td>
<td>0.6512</td>
<td>1600</td>
</tr>
<tr>
<td>250</td>
<td>7</td>
<td>0.6341</td>
<td>1450</td>
</tr>
<tr>
<td>125</td>
<td>9</td>
<td>0.6212</td>
<td>1250</td>
</tr>
</tbody>
</table>

Fig 5.1 describes the fuel cost measurement based on the CPU time. The CPU time is minimal in PSO-NN hybrid technique when compared with the MPC Approach. \( v_n \) particle velocity in the \( nth \) dimensional search space and inertia weight \( d_1 \) and \( d_2 \) reduces the fuel cost to \( 2 - 5 \% \) in PSO-NN hybrid technique. The reduction in fuel consumption reduces the cost in the non-differential areas.

The emission of NOx and SO2 is measured in terms of Kg/hr. The MPC approach [1] emits more toxic gases when compared with PSO-NN Hybrid technique. The emission of gases may affect the plant area (i.e) polluted.
Table II: NO\textsubscript{x} and SO\textsubscript{2} Emission

<table>
<thead>
<tr>
<th>Unit (KW)</th>
<th>Emission (Kg / Hr)</th>
<th>MPC Approach NO\textsubscript{x} Emission</th>
<th>PSO-NN Hybrid NO\textsubscript{x} Emission</th>
<th>MPC Approach SO\textsubscript{2} Emission</th>
<th>PSO-NN Hybrid SO\textsubscript{2} Emission</th>
</tr>
</thead>
<tbody>
<tr>
<td>200000</td>
<td>0.0465</td>
<td>5.1789</td>
<td>0.0422</td>
<td>4.9231</td>
<td></td>
</tr>
<tr>
<td>402400</td>
<td>0.0568</td>
<td>5.9451</td>
<td>0.0519</td>
<td>5.6825</td>
<td></td>
</tr>
<tr>
<td>600080</td>
<td>0.0794</td>
<td>6.5439</td>
<td>0.0732</td>
<td>6.1136</td>
<td></td>
</tr>
<tr>
<td>825460</td>
<td>0.0823</td>
<td>7.1516</td>
<td>0.0783</td>
<td>6.7452</td>
<td></td>
</tr>
<tr>
<td>1020105</td>
<td>0.0865</td>
<td>7.7512</td>
<td>0.0815</td>
<td>7.4258</td>
<td></td>
</tr>
<tr>
<td>1245800</td>
<td>0.0912</td>
<td>8.9592</td>
<td>0.0874</td>
<td>8.5676</td>
<td></td>
</tr>
</tbody>
</table>

Fig 5.2 Graphical form of NO\textsubscript{x} Emission

Fig 5.3 Graphical form of SO\textsubscript{2} Emission

Fig 5.2 and 5.3 describes the gas emission based on the power generation. As the power generated in KW, NO\textsubscript{x} and SO\textsubscript{2} gases emitted in smaller ratio in PSO-NN hybrid technique. The \( E_{qt} = \sum_{i=1}^{QG} e_{iQ} \) and \( E_{ut} = \sum_{i=1}^{QG} e_{iW} \) equations are used to compute the NO\textsubscript{x} and SO\textsubscript{2} gas emissions. The gas emission is controlled the 5 – 10 % emissions when compared with the MPC Approach.

The transmission energy loss is calculated based on the power unit in Mega Watt (MW). The energy loss rate is measured in terms of Joules. The energy loss occurred when the user demand are not satisfied with the generated power. The generated power is destroyed, if it is not in proper utilization. To, overcome this issue, PSO-NN hybrid technique used to improve the transmission rate by minimizing the energy loss.

Table III: Transmission Energy loss rate Tabulation

<table>
<thead>
<tr>
<th>Transmission Power Unit (MW)</th>
<th>( P_{\text{min}} ) (MW)</th>
<th>( P_{\text{max}} ) (MW)</th>
<th>Energy Loss rate (J)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>MPC Approach</td>
</tr>
<tr>
<td>1</td>
<td>15</td>
<td>60</td>
<td>3.5</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>80</td>
<td>4.2</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>100</td>
<td>5.6</td>
</tr>
</tbody>
</table>
Fig 5.4 describes the energy loss rate in joules based on the transmitted unit of power. The transmitted unit of power is taken from 1 to 7 MW. $P_{\text{min}}$ and $P_{\text{max}}$ are the minimum & maximum values of the actual generated power. PSO-NN hybrid technique effectively uses $A_i, B_i, C_i$ and $D_i$ for computing loss coefficients, and $\delta_i$ and $\delta_j$ load angles to accurately judge the energy loss. The energy loss rate is 10 – 20 % lesser when compared with the MPC approach.

VI. CONCLUSION

The monetary burden dispatch is the improvement issue which is unraveled utilizing PSO-NN crossover strategy with lesser transmission vitality misfortune and fuel cost. The PSO calculation is actualized utilizing Matlab programming with fast to gives the $\text{best}$ value with less computational time. MPC approach had experienced on both controlled and deregulated frameworks for taking care of the dynamic financial dispatch issue, where the PSO-NN half breed method takes care of monetary dispatch issue in multi-dimensional, non-straight and non-differential territories. PSO in half and half strategy get an ideal burden planning arrangement and neural system preparing technique used to give compelling result dependent on load request. All generated power units satisfy load demand and controls NO and SO2 emissions using PSO-NN hybrid. The experimental results reveal the practicability and superiority of the presented PSO-NN hybrid against MPC with enhanced NO and SO2 emission control efficiency and 3.27 % decreased fuel cost.

REFERENCES