ABSTRACT

India is facing power shortage in terms of energy and peak demand, the energy shortage being 8% while peaking capacity shortage is about 12%. Government of India (GOI) plans to wipe out the shortage by the end of 2011-12, i.e. by the end of 11th Five Year Plan and also to provide 5% spinning reserve and ensure uninterrupted quality power at affordable cost. The National electricity policy has targeted for providing power to all by 2011-12. Accordingly 68500 MW need-based capacity addition plan has been worked out to be accomplished by March 2012.

As of 31-08-2010, according to the Ministry of Power, the total installed capacity of power plants in India is 1,64,508.8 MW which constitutes thermal, hydro, nuclear and renewable energy. 64.7% is thermal, 24.7% hydro, 2.9% nuclear and 7.7% renewable energy. In Tamil Nadu the total installed capacity is 14638.28 MW out of which 49.4% is thermal, 14.9% is hydro, 4.7% is nuclear and 31.1% is renewable energy. During the 11th Five Year Plan, capacity addition of about 46563 MW coal based thermal power plant is planned. In order to improve the environmental conditions, 6 numbers of 660 MW each unit super critical power plants are under advanced stage of construction. In addition 36 No. of 800 MW each super critical units have been planned to be commissioned during 11th and 12th Five Year Plans of which 8 units are planned to be commissioned during 11th Five Year Plan. Under private sector participation, the Govt. of India has also planned to develop 5 ultra mega power projects of 4000 MW capacity each.
In Chennai two power plants are in operation in North Chennai air basin. They are North Chennai Thermal Power Station (NCTPS), installed capacity 630 MW and Ennore Thermal Power Station (ETPS), installed capacity 450 MW. These two power plants, located on the Bay of Bengal coast, use coal as raw material for power generation. The sulphur content in the coal used is reported to be 0.65%.

Under the expansion program, North Chennai Thermal Power Station is to add another two units of 600 MW each (total capacity being 1200 MW) and this expansion is already in progress. In addition, a joint venture company called NTPC-Tamil Nadu Energy Company Ltd (NTECL) is constructing a power plant at Vallur, the planned capacity being 3 x 500 MW (1500 MW). In the I phase 2 x 500 MW will be installed and in the II phase one more unit (1 x 500 MW) will be added. All these plants will be using coal as the raw material.

Coal fired thermal power plants, though produce more than 40% of world’s electricity, are considered to be a major threat to air pollution. Sulphur-di-oxide (SO$_2$) and particulates are the two major air pollutants coming out from these plants. Air pollutants cause damage to property, vegetation, human health and animals.

Considering the pollution problems of coal fired thermal power plants, the combined SO$_2$ emissions of NCTPS and ETPS have been taken up to assess the performance of Industrial Source Complex (ISC) model ISCST3. This investigation outlines the performance assessment of ISCST3 model in Bay of Bengal Coast in North Chennai air basin in the wake of combined SO$_2$ emissions of NCTPS and ETPS.
In the present investigation, two seasons (winter and summer) have been considered in the performance assessment of ISCST3 model. For these two seasons daily coal consumption were collected from NCTPS and ETPS to work out the SO$_2$ emission rates. Meteorological data for these two seasons were also collected as part of input to the model. All other required input data viz. Stack details, source-receptor co-ordinates were also collected. Using all these data necessary input files were structured suitable to the model.

With the structured input files, the ISCST3 model was run for the two seasons data and the Ground level concentration (GLC) value of SO$_2$ were obtained not only at all the seven receptor points but also at every grid points designed for an area of 10km x 10km with a grid interval of 1km. Using these SO$_2$ values at the grid points, spatial distribution plot for SO$_2$ were drawn for all the days. From these spatial distribution plots, predicted daily maximum SO$_2$ values were picked up for comparing with the maximum observed SO$_2$ values through statistical analysis.

Statistical analysis was performed to assess the performance of ISCST3 model for the combined SO$_2$ emissions of NCTPS and ETPS which are located right on the coast of Bay of Bengal. Four parameters viz. Fractional Bias (FB), Normalised Mean Square Error (NMSE), Correlation Coefficient (COR) and Index of Agreement (IA) were used in statistical analysis. The result of the analysis shows that IA varies from 0.5580 to 0.6562 in winter season whereas for summer season it varies from 0.5277 to 0.8435. As far as COR is concerned it varies from 0.7336 to 0.8834 in winter season whereas for summer, it varies from 0.217 to 0.6013. In summer lot of variation is noticed in the predicted and observed SO$_2$ values. In case of NMSE, it varies from 0.3663 to 0.6736 in winter season and 0.1275 to 0.6802 in summer season. FB varies from 0.2826 to 0.6741 in winter and -0.0594 to 0.7368 in summer.
IA varies from 0 to 1 (poor to perfect agreement). The values of IA should be close to 1 and NMSE should be close to 0 (zero) for good performance. Values for FB range between -2.0 (extreme under prediction) to +2.0 (extreme over prediction). Model predictions with a FB of 0 (zero) are relatively free from bias.

Hence, in an overall sense, considering the statistical analysis results and comparing with the studies made elsewhere, we can confidently say that the performance of the model is good for predicting the combined SO$_2$ emissions of NCTPS and ETPS in winter and summer seasons in the Bay of Bengal coastal environment.