Chapter - 7

CONCLUSIONS AND RECOMMENDATIONS

The present research has been undertaken to evaluate the current performance level of thermal power plants in India by incorporating key decision variables describing plant performance, meeting academic's requirement for rigour and provide a simple and practical approach which can be applied by the practitioner to set SMART targets for performance improvement. The study attempted to analyse the trend of key performance parameters and understand seasonal variations using ANOVA and Games-Howell post hoc test. Using linear programming based Data envelopment Analysis (DEA), the performance of thermal power plants are evaluated to quantitatively estimate current performance levels, identify performance gaps and set targets for achievement based on the actual performance of the plants and identify benchmarks for different plants. Impact of environmental variables like geographical location, ownership structure, size and age of the units on plant performance are analysed using ANOVA and Games-Howell post hoc test. Productivity changes of the plants are estimated using distance function based Malmquist Productivity Index (MPI). Conclusions, policy implications for the industry and academia, limitations of the current study followed by scope for future research is detailed in this chapter.

7.1 Conclusions

Performance evaluation of thermal power plants in Indian context is mostly limited to technical parameters. Ratio analysis based partial approach is adopted for performance evaluation in which a number of ratios like PLF, OAF, PM, FO, SCC, APC, SFOC etc are used as key performance parameters. While higher PLF and OAF are indicators of good performance, lower PM, FO, SCC, APC, SFOC and maintenance expenditure indicate good performance.

Partial approach is used for performance evaluation of power plants in which one ratio is compared at a time. A common practice in industry is to compare the performance of plants based on PLF only. This approach only provides information about that parameter remaining silent about other parameters. Attempts have been made to evaluate the overall performance of plants by aggregating through a weight vector which again suffers from subjective bias associated with selection of weights.

It is observed that there is substantial gap in the performance of thermal power plants. Bridging the performance gap has the potential to make available more, reliable and cheaper power. Several attempts have been made by industry bodies, Govt. of India and regulators to encourage performance improvement through awards, incentives and disincentives. Benchmarking is recognized as a tool for performance improvement. Average method is adopted for target setting in which performance targets for the underperforming plants is set to industry averages.

7.1.1 Performance Trend

Improved operation and maintenance practices have reduced the planned maintenance and forced outage durations from 24.19% (FY85) to 7.71% (FY08) respectively resulting in higher plant availability from 64.68% (FY84) to 84.76% (FY08) leading to increased plant load factor from 46.07% (FY84) to 78.75% (FY08).

It is found that average availability level during different months is not uniform. Availability is highest during March and lowest during August with a gap of 8.4%. Maintenance activities are not planned uniformly round the year. While more maintenance activities are planned during August; less during March and the gap being 7.78%. The planned maintenance duration is not uniform for different operators. Dahanu plant of REL has lowest PM durations.

Generation loss due to forced outage even though have reduced over the years, still remains a cause of concern. During FY04 and FY08, even though a number of units have been added, there has been a decline in the number of outages (from 8400 outages to 6600). During a year about 7000 outages are observed causing generation loss to the tune of about 50 BU amounting to 65% of energy shortage. An outage causes average generation loss of 6.72 MU. However the generation loss per outage has increased over the years (5.78 MU to 7.34 MU). Outages due to boiler not only cause maximum outages but also cause highest loss of generation. Single boiler outage caused average loss of generation to the tune of 6.03 MU during FY08. In boiler outage category, Water wall failure causes maximum outages and generation loss.

During FY04 and FY08, both the 250 MW and 500 MW groups of units have recorded no outage on account of AVR Problem, Explosion, Generator Winding

Temperature High, Commissioning Period, Cooling Tower, DM Water Problem, Poor Coal Quality, Condenser, Curtis Wheel Pressure High and BFP Motor.

The 250 MW group of units have not recorded any unit outage on account of Hydrogen System, Other Boiler Problems, Miscellaneous Fire Problems, Stator Cooling Water Resistivity, Ash Handling System, Breaker / Isolator, Feeding Trouble, HT / LT Motors, Raw Water Problems, Wet Coal, Control Valve, Rotor Blade Failure / Fouling, Turbovisory System, Condensate Pump and De-aerator problems which are being experienced by 500 MW units. Operation and Maintenance practices of 250 MW group of units can be emulated by 500 MW units to reduce forced outages due to these causes.

Variation of forced outage durations in different months is not significant.

7.1.2 Performance Evaluation

The study revealed that all the power plants are not operating at their optimum level and there is substantial scope for improvement. Average technical efficiency by taking constant return to scale (CRS) assumptions is found to vary between 40% and 100% with mean value of 80%. By taking scales of operation into account, this varies between 51% and 100% with average value of 83%.

With performance improvement, power generation from 60 GW of installed capacity could be achieved from 49 GW; reduction of coal consumption by 46 million tones and auxiliary power consumption by 7.2 BU; reduction of PM durations from 7.5% to 3.9% and FO durations from 9% to about 1.8%.

Out of the 74 plants, 16 plants occupy the efficiency frontier and considered to be sources of best practices for other plants. Dahanu plant (mostly during FY07) is frequently referred by other plants as peer.

The study revealed that the technical efficiencies of the plants vary with the age and capacity of the units. However no interaction is observed between them. Newer plants are more technically efficient. Plants having average unit size of 500MW and 250MW are technically most efficient.

It is found that the technical efficiencies of the plants vary across different geographical regions; plants in Southern Region perform better in comparison to those in Northern Region and Eastern Region by 8.4% and 7.1% respectively.

Technical efficiencies of the plants vary across different management structures. Technical efficiencies of plants in Private Sector are more compared to those in Central and State Sector by 5.4% and 14.32%.

7.1.3 Productivity Change

It is found that during the period of study, FY04 to FY08 the power plants recorded annual productivity growth of 1.2% of which 0.9% was due to efficiency change indicating catch-up and 0.2% due to technical change indicating technical innovation. Efficiency change of 0.9% when further decomposed indicate 0.7% of pure efficiency change and 0.2% scale efficiency change.

While plants in Eastern, Southern and Northern Region witnessed annual productivity growth of 2.2%, 2.0% and 1.3%, plants in Western Region recorded negative growth of 0.04%.

Plants in State and Central Sector which are found to be less technically efficient compared to those in Private Sector, registered productivity growth of 0.4% and 4.2% respectively.

While 42 plants recorded productivity growth during FY04 to FY08, 12 plants recorded all round growth in pure efficiency, scale efficiency and technical change. Six of these plants are located in Eastern Region, four in Northern Region and one each in Western and Southern Region. Seven of these 12 plants are managed in Central Sector followed by four in State Sector and one in Private Sector.

7.2 Policy Implications and Recommendations

The study attempted to apply mathematical modeling to address the challenges being faced in the performance evaluation of Indian coal fired thermal power plants which shoulder a great responsibility in powering socio economic growth incorporating multiple decision variables and using state of the art performance evaluation techniques. As the study is based on actual industry performance, the results are likely