Summary of Ph. D. Thesis on

Management of Thermal Power Plant Performance Parameters

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During the early stage of accelerated electricity growth, generation capacity enhancement was not followed by capacity utilization, which have been assessed by very low plant load factor of the order of 55.9%, 51.4%, 48.3%, 44.7% and 44.6% for the financial years 1976-77, 1977-78, 1978-79, 1979-80 and 1980-81 respectively. Reasons identified for poor performance include design deficiencies, manufacturing/ generic defects, O & M shortcomings, inadequacy of spare parts, lack of funds, poor coal quality and inadequately trained manpower for the operation and maintenance of the plants. Recognizing this, the Government of India launched performance improvement by renovation and modernization of old thermal power units of the country, way back in 1984 as a centrally sponsored scheme under supervision of the Central Electricity Authority. Over all efforts of power personnel has enhanced the average plant load factor (PLF) to 76.2% for 2006-07, comprises of 85.8% of central sector, 68.1% of state sector and 92.8% of private sector.

This value of PLF is quite high but it cannot be appreciated because of exorbitantly high cost to the nation because of very poor energy efficiency parameters, equipments life parameters and environmental pollution parameters. Station heat rate is most important energy efficiency parameter, the all India average value of which is reported to be deteriorated by 3.35% during the year 2006-07 over the preceding year. Not even a single thermal unit is achieving the design prescribed efficiency and many of the units are loosing more than 20% efficiency. As regards with existing standards of equipment life and human safety related parameters, we are running our thermal units in relatively much poor conditions. The Ph. D. Thesis on "Management of Thermal Power Plant Performance Parameters" deals with examination and analysis of deterioration of the various performance parameters due to wide variation of input parameters from the design prescribed values.

Energy converters, heat exchangers, fluid machines, electric motor/ generators/ transformers, valves etc facilitate mass and energy transfer in the desired direction. Flow synthesis of power plant sub system and processes simplify the thermal power plant functioning and relate the process parameters for easy examination and analysis. Starting from visualizing the entire thermal power plant as simplest profit making business unit, mass and energy flow diagrams of all the important subsystem have been drawn.

All the important inputs are visualized as primary causes and attempts are made to keep vigil over immediate effect, which becomes second cause and incorporate the similar change in the second effect and so on, for better regulation of the processes. Such dynamic behaviour of power plant processes has been drawn as causal diagram in the form of process parameter relationship. Most desired out put parameter of the sub system is directly or indirectly connected to its' input/operating parameters along with plus or minus sign as an indicative of the kind of influence on the output either due to inevitable variation in uncontrollable input parameters or due to deviation in controllable operating parameters. All the causal diagrams of the subsystems have been integrated indo a grand system dynamic model, which indicates the directional quality behavour of the thermal power plant process equipments and processes.

Uncontrollable input parameters are required to be managed by suitable variation in controllable input parameters and operating parameters to minimize the adverse effect on

different power plant performance parameters. This needs managerial will along with clear determination of scientific approach and limitation, which help in determining the inevitable and avoidable component of the deteriorated loss of performance on account of variation in input parameters from the design prescribed values.

Basic input, ultimate output and operating parameters are connected in a complicated manner. Managerial aspects of these parameters have been analysed and examined with reference to the power generation processes and associated equipments. Identification of the input parameters as controllable, semi-controllable and uncontrollable, help in deciding the appropriate action to accommodate variations in uncontrollable input parameters by suitably modifying the controllable input and operating parameters so that the adverse effect on performance can be minimized. Attempts have been made to inculcate the managerial will to accurately monitor the variations in different input parameters and suitably accommodate these variations, to minimize the anticipated adversity on performance.

In order to evolve operator friendly guide message under various operating condition, exergy and energy efficiency parameters have been determined. So estimated theoretical values of the performance control parameters are compared with measured values, difference of which become the potential for optimization and improvement. Though this work has briefly covered all most all the parameters from basic input to the desired output and waste disposals but the techno managerial attention has been invited towards very few, which have seemingly visible scope of improvement. These are;

- Coal parameters influence the performance of combustion and steam generation equipments. Guiding information on mill capacity variation, combustion air modification and flue gas volume regulation have been proposed.
- New method for estimation of excess air by incorporating coal parameters has been worked out. This amount of excess air has been converted to the corresponding value of O_2 % in flue gas for the ease of concerned operator.
- Inevitable effect on condenser vacuum due to variation in cooling water temperature has been determined, compared with actual to determine avoidable loss of condenser vacuum, which can be minimized by practicing the proposed means and methods.
- Initial establishment of boiler feed water flow procedure has been proposed to be modified.
- Boiler blow downs are proposed to be modified in accordance with the authentic operation guide lines and sample tests for total dissolve solids.
- Indian boilers are highly susceptible for flue gas erosion, quantitative changes to which due to variation in various input and operating conditions have been estimated and remedial measure also have been proposed.
- Flue gas exhaust temperature minimization means and methods have been proposed.
- Auxiliary consumption is also vital issue of Indian thermal power stations and hence covered under this work for the minimization.

Most of the proposed solutions are costless and can be implemented for any thermal power station by devoted techno managerial will. The research has established the need of modifying the controllable input parameters and operating parameters to accommodate wide variation of uncontrollable input parameters to minimize the adverse effect on various performance control parameters. Implementation of established facts and proposals lead to improve the thermal power plant performance in terms of availability parameters, efficiency parameters, equipment life parameters and human safety parameters.