Habib (1994) presents an analysis of a cogeneration system. The analysis quantifies the irreversibilities of the different components of each plant. Additionally, the influence of the heat-to-power ratio and the process pressure on the thermal efficiency and utilization factor is presented. The results show that the total irreversibility of the cogeneration plant is 38 percent lower compared to the conventional plant. This reduction in the irreversibility is accompanied by an increase in the thermal efficiency and utilization factor by 25 and 24 percent, respectively. The results show that the exergy destruction in the boiler is the highest.

Bejan, et al (1996) Provides comprehensive and rigorous introduction to thermal system design and optimization from a contemporary perspective. The book includes current developments in engineering thermodynamics, heat transfer, and engineering economics relevant to design. The use of exergy analysis and entropy generation minimization is featured. A detailed description of engineering economics and thermo economics are also presented. Moreover, a case study is considered throughout the book for continuity of the presentation. The case study involves the design of a gas turbine cogeneration system.

Rolf Kehlhofer (1997) provides the study of thermodynamic principles of combined cycle power plants and co-generation system. The book includes the different layout system of combined cycle power plants. It describes the effect of operating variables and part load behavior of combined cycle power plants.

Karthikeyan et al (1998) gives energy balances for a one pressure level heat recovery steam generator. Effects of pinch and approach points on steam generation and also on temperature profiles across heat recovery steam generator are investigated. The effects of operating conditions on steam production and also on exit gas temperature from the heat recovery steam generator are discussed. It is concluded that low pinch point results in improved heat recovery steam generator performance due to reduced irreversibility’s. Additionally, the supplementary firing enhances the steam production.

Tawney, et al. (2000) focuses on several ranges of process steam flows and conditions in order to provide a basis for comparison of the most common cycle configurations in combined cycle applications. Plant design, cycle performance, and
economics of each configuration are evaluated based on requirements of flexibility and process steam flows. Rather than self-establishing the energy balances, Gate Cycle TM Heat Balance software developed by GE Enter Software, Inc. is used to build thermal models. Additionally, a financial software tool developed within Bechtel is used to construct an economic model for each cycle configuration. It is concluded that, the selection of a cogeneration facility type and the economic parameters are very much site specific and are based on numerous variables such as site ambient conditions, the level of desired power output and steam demand, capacity factor, flexibility, power purchase agreement and steam purchase agreement requirements, and owner’s economic parameters for return on equity.

Boyce (2002) covers all major aspects of power plant design, operation, and maintenance. It covers cycle optimization and reliability, technical details on sizing, plant layout, fuel selection, types of drives, and performance characteristics of all major components in a cogeneration or combined cycle power plant. Comparison of various energy systems, latest cycles and power augmentation techniques, reviews and benefits of latest codes, detailed analysis of available equipment, techniques for improving plant reliability and maintainability, testing and plant evaluation techniques, and advantages and disadvantages of fuel are also included in this book.

ET. Bonataki and K.C. Gianna Koglou (2002), give a modern optimization methods based on evaluationary algorithms and game theory. They will be supported by computational methods for their thermal analysis and simple model for computing there capital cost. In this paper a detailed thermal model and a quite simple economical model will be incorporated in an evolutionary search algorithm and an automated tool combine the design of new cycle gas turbine power plant will be demonstrated. The search algorithm is used a Genetic Algorithm (GA) for single and multi objective optimization problems. The later is handled through game theory inspired enhancement to the G.A. based search yielding the so called optimal Pareto front, with two objectives (viz electrical efficiency and investment cost), the Pareto front members can be envisaged as compromise between high cost/high efficiency and low cost/low efficiency design.

Neil Petchers (2003) provides a comprehensive and rigorous introduction to thermal system design from a contenpeary perspective. First part of the book provide a theoretical basis for understanding the inter relation of heat and power resources. It
provides an introduction to basic heat and power thermodynamic and includes sections on heat and power generation technologies and equipment. Part seconds describe the infrastructure in which the theory and technologies describe in part first must be applied. Having learned on the theory and available technology, application cannot be effective device, analysis’ for cost effectiveness and implemented without knowledge of environmental factors and utility rate structures.

Yongjun Zhao, et al (2003), the objective of this paper is to parametrically investigate the design and cost of HRSG system and to demonstrate impact on the overall cost of electricity (COE) of a combined cycle power plant. There are numerous design parameter that can affect the size and complexity of the HRSG, and it is the plan for the project to identity all the important parameter and to evaluate each the exhaust gas pressure drop across the HRSG is chosen for evaluation. This parameter affects the performance of both the gas turbine and steam turbine and size of HRSG. Single pressure, two pressure, and three pressure HRSG are investigation with the tradeoffs between design point size, performance and cost evaluated for each system. A genetic algorithm is used in the design optimization process to minimize the investment cost of the HRSG second system level metrics’ are employed to evaluate a design. They are gas turbine net power, steam turbine net power, fuel consumption of the power plant, net cycle efficiency of the power plant, HRSG investment cost, total investment cost of the power plant and the operating cost measured by the cost of electricity (COE), The impacts of HRSG exhaust gas pressure drop and system complexity on these system level metrics are investigated.

Zaleta-Aguilar Alejandro (2003), in the paper exergoeconomic fuel-impact models for steam turbines in power plants is proposed. They are applied to calculate the impact on the steam cycle when malfunctions are occurring during the operation of steam turbine sections. Concepts such as the exergetic consumption and the dissipation temperature are used to understand the proposed fuel-impact analysis. In order to validate these fuel-impact methods, well-known procedures, to simulate on and off-design conditions of a steam power cycle are used as references. Three different methods.

a). ASME PTC-6,

b). Existing fuel-impact formula,
c). Proposed exergoeconomic fuel-impact formulation are compared with respect to the simulator results.

The proposed models allow evaluating fuel-impact cost with more accurate results than conventional procedures. An example of a 158 MW conventional power plant is presented herein. The malfunction costs occurring in the steam turbines are inferred from the results. One perspective of this analysis is to establish an on-line monitoring system into power plants that permits to opportunity detect steam turbine malfunctions, without simulators.

Chih Wu, (2004) United States, naval academy Annapalis, mary land USA, provide an intelligence computer software called “cycle pad”. It is powerful, mature, user friendly package developed to simulate thermodynamic devices and cycles. It makes feasible for engineers to run meaningful sensitivity analysis to consider combinations of design modifications to make engineering cost benefit analysis and to include refinements such as accounting for pressure changes and heat transfers occurring between major cycles components.

Yadav, et al (2004) in this paper author emphasis on to development of gas turbine related power plants such as combined cycle and steam injected is on increasing the plant efficiency and specific work while minimizing the cost per KW and emission. The work deals with the thermodynamic analysis of inter cooled (both surface and evaporative) gas steam combined analysis injected power plants. There exists an optimum intercooling pressure which influences the performance with reference to plant efficiency. Author conclude that the intercooling has a beneficial effect on both plant efficiency and specific work if the optimum intercooling pressure ratio is chosen 3 to 4. As expected the higher TIT and $r_{pc}$ results in better performance. However due to transpiration air cooling their existing an optimum $r_{pc}$ at higher TIT in the case combined cycle but it is not observed in the steam injected cycle. The blade requirement is less with low inter cooling pressure ratio. As $r_{pc}$ increase the coolant requirement increases for same TIT. The evaporator type of intercooler is superior to surface type by percentage point. The plant efficiency of intercooled steam injected cycle 1000 K. The exergy analysis quantifies the losses in the component and it is maximum in combustors following by gas turbine in combined cycle where as it is following by HRSG in steam injected cycle.
Mitre, *et al* (2005), In this paper, author evaluates the effect of operational conditions on pollutants (CO, CO$_2$, SO$_2$, NO) emissions levels, waste heat and waste water of a combined cycle natural gas and steam power plants. The HYSYS process simulation was used for modeling and simulation. This study clearly shown that the absolute quantity of pollutants emitted is high. Also it was possible to verify that the unit operation in the condition of minimal emissions regarding the maximum possible, and thus a reduction or elimination of such pollutants is not possible. It can be observed from this study that the ideal condition for exergy productivity is to operate with a fuel air ratio as the stoichiometric one. The first constraints to this ideal is the mechanical conditions of the turbine, which can be operate at the corresponding combustion gas exit temperature so a stoichiometric ratio in the range of (2.7-2.9) is used, and these conditions make the process viable (turbine viability) and minimize pollutants production (CO and NOx). These operational conditions are the optimal considering environmental concerns. The CO$_2$ being a product, is maximized in the process, so there is no need to search for methodologies to minimize their production, but there is for technologies for their capture and uses parallel to the process.

Xiaojun Shi and Defu Che (2007), this paper proposed an improved Liquefied Natural Gas (LNG), fuelled combined cycle power plant with a waste heat recovery and utilization system. The proposed combined cycle, which provide power output and thermal energy, consist of gas/steam combined cycle, the subsystem utilization the latent heat of spent steam from the steam turbine to vaporize LNG, the sub system that recovers both the sensible heat and latent heat of water vapour in the exhaust gas from heat recovery steam generator (HRSG), by installing a condensing heat exchanger, and the HRSG waste heat utilization sub system. The conventional combined cycle and proposed combined cycle are modeled, considering mass, energy and exergy balances for every component and both energy and exergy analysis are conducted. Parametric analysis are performed for the proposed combined cycle to evaluate the effect of several factors, such as the gas turbine temperature (TIT), the condenser pressure, the pinch point temperature different of the condensing heat exchanger and fuel gas heating temperature on the performance of the proposed combined cycle through simulation calculation. The results show that the net electrical efficiency and the exergy efficiency of proposed combined cycle can be increased by 1.6% and 2.84% than those of the conventional combined cycle.
respectively. The heat recovery per kg of flue gas is equal to 86.27 kJ/sec. one MW of electric power for operating sea water pumps can be saved. The net electric efficiency and heat recovery ratio increase as the condenser pressure decreases. The higher heat recovery from HRSG exit flue gas is achieve at higher gas TIT and at lower pinch point temperature of condensing heat exchanger.

Srinivas, et al (2008). In this paper author study the optimum configuration for single pressure (SP), dual pressure (DP) and triple pressure (TP) heat steam generator (HRSG) to improve heat recovery and exergy efficiency of combined cycle. Deaerator was added to enhance efficiency and remove dissolve gases in feed water. A new method was introduced to evaluate low pressure (LP) and intermediate pressure (IP) in HRSG from local flue gas temperature to get minimum possible temperature difference in heaters instead of a usual fixation of pressures. Optimum location for deaeraor was found at 1, 3, and 5 bar respectively for SP, DP and TP in heat recovery at a high pressure (HP) of 200 bar. It is concluded that optimum pressure ratio for compressor with SP, DP and TP effects in heat recovery are 8, 10 and 12 respectively at 1200°C of gas turbine inlet temperature optimum deaerator pressure is obtained at 1.3, and 5 bar for SP, DP and TP levels respectively at steam turbine inlet pressure of 200 bar. Similarly at 200 bar of HP pressure for DP and TP, steam reheated demands 100 bar to maximize exergy efficiency for combustion chamber. Parametric analysis exhibits that gain in efficiency from single pressure heat recovery to DP and TP recovery increasing with diminishing rate.

**Objectives of the thesis**

1. One designer claim that only 20% of total station output should be supplied by gas turbine and the remaining by steam turbine for maximum operating flexibility in serving in middle range of load. Another designer claim as much as 80% of total energy must be supplied by gas turbine and remaining by steam turbine. The object of the proposed research is to analyze this information and find out the best mixing combination of steam and gas power plant.

2. To study the effect of operating parameters such as compression ratio, air inlet temperature, turbine inlet temperature, gas turbine exhaust temperature, pinch
point, reheating, regeneration effect, etc, on the overall efficiency of the combined power plant.

3. Techno economics of the combined cycle power plants considering various combinations.

4. The present work investigates three different approaches to this problem: (i) the most conventional open-loop air cooling; (ii) the closed-loop steam cooling for vanes and rotor blades; (iii) the use of two independent closed-loop circuits; steam for stator vanes and air for rotor blades.