International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 15
May 2018

"Exergy and Energy Analysis"

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A B S T R A C T

In this study, the energy and exergy analysis of Reliance Ultra Mega Project (3960MW) in Singrauli ,Madhya Pradesh is presented. The primary objectives of this paper are to analyze the system components separately and to identify and quantify the sites having largest energy and exergy losses. In addition, the effect of varying the reference environment state on this analysis will also be presented. The performance of the plant was estimated by a component-wise modeling and a detailed break-up of energy and exergy losses for the considered plant has been presented.

INTRODUCTION

Power have a major contribution in human beings life and works like in industries, agriculture, transportation etc. power gives our houses with electricity and heat. The lifestyle and prosperity of a nation vary directly propotional to the use of power.

The technology advancement had increased the consumption of power is steadily .This necessitates that in addition to existing sources of power like coal, water, petroleum etc. other sources of power should be searched out and new and more efficient ways of production energy should be devised. Nuclear energy has enlarged the world's power resources. But there are gaps between power station and human settlement in developing countries such India.

Ultra Mega Power Projects (UMPP**)** are a series of ambitious power stations planned by the Government of India. This would create additional capacity of at least 100,000 MW by 2022. Ultra Mega Power projects, each with a capacity of 4000 MW or higher, are being developed with the target of bridging this gap.

The UMPPs are expansion of the MPP (Mega Power Projects) projects that the Government of India launched in the 1990s, but met limited success. The Ministry of Power, in association with the Central Electricity Authority and Power Finance Corporation Ltd., has started an initiative for the growth and development of coal-based UMPP's in India. These projects will be given to developers on the basis of competitive bidding

Based on supercritical technology, 16,000 MW of capacity has been contracted through the competitive bidding process for UMPPs. The average tariff for these projects varies from 2-3 per kWh which is much lower than the recent cost plus tariffs.

There are a few methodologies to measure the performance of a power plant. Some researchers use the conservation of mass and the conversion of energy (first law of thermodynamics) principles: however the evaluation is actually not complete. The exergy analysis based on the second law of thermodynamics should be included in order to provide the information, which is useful for engineers or managers to know about the power plant performance. Although the method of exergy is often considered to be a new method for analyzing energy systems, the underlying fundamentals were introduced as early as in the 1940's.

As energy analysis is based on the first law of thermodynamics, it has some properties of the system environment, or decrease of the energy quality through dissipative processes. An energy analysis does not characterize the irreversibility of processes in the system. In exergy analysis will designate the work potential of system. Exergy is the maximum work that can be achieved from the system, when its state is taken to the reference or "dead state" i.e. standard atmospheric conditions. Exergy analysis is based on the second law of thermodynamics Energy analysis of a thermal power plant, in order to estimate the distribution of irreversibilities and losses which causes loss of efficiency in system performance.

DESCRIPTION OF THE SYSTEM:-

The twin shell condenser is linked with a exhaust part of low pressure turbine casing. The condenser is made to create the vacuum at the exhaust of low pressure steam turbine and to give pure condensate for recycling for the boiler. The steam is condensated as the tubes through which cooling water is passed. The condensate water is accumulated in hot-well. There two condesate pump which are pumping the condensate water from the hot-well to the deaerator by low various heat-exchangers. One pump is for normal operation one is for standby operaton. Condensate water is pumped by condensate extraction pump from the hot-well and supplied to side of air ejector. Two air ejectors are fixed; one air ejector is running and other is for standby. The two stages steam jet air ejector is use removing air vapor so that vacuum is created inside a condenser. The steam for air ejector is taken from the manifold, which is charged to steam receiver. The steam, which is supplied to air ejector provide some thermal energy to the condensate water, which is pumped through CEP and temperature get higher .

BOILER

Boiler is an equipment used to provide steam. Thermal energy released by combustion of fuel is delivered to water which vaporizes and gets changed into steam at the required pressure and temperature, the steam produced come out for:-

(i) Generating mechanical work by expanding it in steam engine or steam turbine.

(ii) Heating the residential and industrial buildings.

(iii) Performing few processes in the sugar mills and thermal power plant

SUPERHEATER

The steam produced in the boiler is nearly saturated. This steam as such should not be used in the turbine because the dryness fraction of the steam go away from boiler will be low. This results in the presence of mixture which causes corrosion of turbine blades to raise the temperature of steam, super-heated is used. It consists of number of tube in parallel with one or more return bends connected between headers. Super-heater Supplies steam at constant temperature at various loads.

METHODOLOGY:-

- The mass flow through the system remains same.
- Fluid is homogeneous in composition.
- The only interaction between the system and the surrounding are work and heat.
- The state of fluid at any point remains constant with time.
- The energy and exergy destroyed by K.E. and P.E. are negligible.
- No chemical reaction takes place.

The components of the plant are grouped into two subsystems which are boiler subsystem and turbine subsystem. The components of the boiler subsystems are combustion chamber, primary super-heater, de-super-heater, secondary super-heater, economizer and air pre-heater. Turbine subsystems are, the turbine, condenser, feed water heaters, de-aerator, drain cooler, pumps, circulating water pumps. The mass flow of energy and exergy across the control surface have been used for the energy and exergy analysis calculation of the individual subsystem.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
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The exergy analysis has been taken away for each and every component of the system, and we calculate the exergy losses in the each and every components and then analysis is performed on the overall individual subsystem. Finally the exergy analysis for the overall plant has been estimated. The energy and exergy losses of the components of each system have been determined using their mass by using energy and exergy balance equations.

The exergy destructions for each components and subsystems are compared and presented. The energy and exergy efficiencies have also been counted for the each and every components as well as for the overall plant.

BOILER SYSTEM

The energy loss (Q) of the subsystems are determined using the energy balance of the first law of thermodynamics and similarly the exergy losses are calculated from the exergy balance equation of the second law of thermodynamics. Then using the energy losses, the energy efficiency is calculated and the exergy efficiency is also calculated using the exergy losses. Figure shows the schematic diagram of boiler subsystem.

CONCLUSION

1. It has been indicated that condensor and economiser (heat exchanger) are main parts that contributed loss of exergy

2. It has been shown that 53.65% exergy loss occur in boiler which indicates that boiler is not fully adiabatic and combustion may not be complete. It is caused by the irreversibility within the combustion process. This study indicates that the boiler requires modification like insulation modification.

3. The major loss in energy happens in the heat recovery system which causes inefficient heat transfer in hot stream (flue gas) and cold stream (water).It shows that heat exchanger system needs to be inspected.

4. HP and IP turbine have high performance because it nearly adiabatic and LP turbine have lower performance in comparision

REFERENCES

[1] Energy And Exergy Analysis Of a 26MW Thermal Power Plant- Rakesh Kumar Singh & Dr. Jeetendra Kumar Tiwari , International Journal For Technological Research In Engineering Volume 3, Issue 9, May-2016

[2] EXERGY ANALYSIS OF THERMAL POWER PLANT (RTPP) -B. Yeswanth Kumar Reddy, G. Venkata Subbaiah Yadav, S. Pavan Kumar, M. Ashok Kumar

[3] THERMAL ANALYSIS OF ENERGY AND EXERGY OF BACK PRESSURE STEAM TURBINE IN SUGAR COGENERATION PLAN -Pratap Smore, Prof. Azim Aijaz ,International Journal of Emerging Technology and Advanced Engineering, Review 2014

[4] Energy and Exergy Analysis of Coal Fired Power Plant H Ravi Kulkarni ; Prof P.P.Revankar 2; Prof S.G.Hadagal, International Journal of Innovative Research in Technology & Science(IJIRTS),ISSN:2321-1156

[5] EASY METHOD OF EXERGY ANALYSIS FOR THERMAL POWER PLANT -Mali Sanjay , Dr. Mehta N,International Journal of Advanced Engineering Research and Studies,E-ISSN2249–8974

[6] Energy and Exergy Analysis of Thermal Power Plant V.Satish, V.Dhana Raju,M.Tech Student,Sr.Assistant Professor, IJESC , Volume 6 Issue No. 8

[7] Energy and Exergy Analysis of CFBC Boilers Pallavi Pathi, Twinkle Mishra , Subhasis Padhi, International Journal of Recent Trends in Engineering & Research (IJRTER)Volume 02, Issue 03; March - 2016 [ISSN: 2455-1457]

[8] Energy & Exergy Analysis of Thermal Power Plant at Design and Off Design Load Rakesh Dang1, S.K. Mangal, Gaurav, International Advanced Research Journal in Science, Engineering and Technology Vol. 3, Issue 5, May 2016