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RESEARCH ARTICLE

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RESEARCH ON SURFACE CONDENSER IN THERMAL POWER PLANT AND IDENTIFYING METHODS TO RESOLVE THE PROBLEMS IN THERMAL DESIGN

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ABSTRACT
This document gives detailed information on the function of Surface Condenser in Thermal Power Plant. The identification of problem in the thermal design of surface condenser is also mentioned i.e. maintaining low back pressure (vacuum). Among the different methods for thermal design of steam surface condenser, HEI method is proved to be more practical and widely used in industries throughout the world. Existing method for thermal design of surface condenser does not achieve the HEI method values. Hence, analytical approach is necessary for implementing new method for thermal design of surface condenser to achieve the HEI method values.

I. INTRODUCTION

A complex of structures, machinery and associated equipment for generating electrical energy from other source of energy such as thermal energy, nuclear energy, and wind energy is called as power station.

Condensers are most important part of thermal power plant. Condensers are shell and tube heat exchangers which remove the unavailable and available energy degraded by irreversibility from the plant cycle and improve the cycle efficiency. In condenser, steam loses its latent heat to cooling media i.e. water. In a thermal power plant steam surface condenser serves to maintain a very low back pressure on the exhaust side turbine, the steam expands to a greater extent which results in an increase in available heat energy for converting into mechanical work.

II. THEORY

The desirable features of a condenser are:

- Minimum quantity of circulating water should be used.
- Minimum cooling surface per KW.
- Minimum auxiliary power.
- Maximum steam condensed per square meter of surface and heat transfer.

Primary functions of condenser:

a. To condense the steam exhausted from the turbine to enable recycling of condensate.
b. To maintain vacuum so that heat utilization in the turbine is optimum.
c. To maintain the temperature of the condensate to minimize thermal losses.
d. To prevent the under cooling of the condensate.
e. To facilitate the extraction of the air and other gases to maintain high level of performance.
f. To receive sub atmospheric drains.

Advantages of condenser:

a. The use of condenser in the power plant improves the efficiency of the power plant by decreasing the exhaust pressure of the steam below atmospheric.
b. Another advantage of the condenser is that the steam condensed may be recovered to provide a source of good pure feed water to the boiler and reduce the water

softening plant capacity to a considerable extent.

c. Reduces the cost of the plant and power generation cost.
d. The efficiency of the plant increases as the enthalpy drop increases by increasing the vacuum in the condenser.

Types of condensers:

1. Direct contact or mixing or jet type condensers
2. Surface condensers
3. Air cooled condensers

Surface condenser

In surface condenser, there is no direct contact between the steam to be condensed and the cooling water. There is a wall imposed between them through which heat is transferred by conduction and convection. The temperature of the condensate may be higher than the cooling water at exit because the circulating water at exit and cooling water do not mix. A typical image of surface condenser is shown below.

The condensate is recovered as feed water to the boiler. Both cooling water and condensate are separately drawn. The recovery is very important for marine engines which carry a limited amount of pure water. Marine installations are therefore equipped with surface condensers. Steam power plants are equipped with surface condensers.

III. IDENTIFICATION OF PROBLEM IN THERMAL DESIGN OF SURFACE CONDENSER:

If the circulating cooling water temperature is low enough, as in the case, it creates a low back pressure (vacuum) for the turbine to exhaust to this pressure is equal to the saturation pressure that corresponds to the condensing steam pressure. As is now known as enthalpy drop and hence the turbine work per unit pressure is much greater at low pressure than the high pressure end of a turbine.

IV. SOLUTION TO THE PROBLEM

A condenser, by lowering the back pressure, increases the work of turbine, increases the plant efficiency and reduces the steam flow for a given plant output. Lower the pressure, greater the effects. Hence thermodynamically, it is important to use cooling water which is at lower temperature. Similarly the back pressure of condenser is dependent on various parameters like steam flow rate, cooling water velocity, overall heat transfer co-efficient, effectiveness etc.

V. RESULTS AND DISCUSSIONS

Among the different methods for thermal design of steam surface condenser, HEI method is proved to be more practical and widely used in industries throughout the world. But, simulating exact site conditions is possible only by incorporating various influencing parameters into thermal design which cause the effects on rated output of the turbo generator unit at site. Hence it is necessary to calculate back pressure by using heat transfer co-efficient and corresponding back pressure at various site conditions by theoretical method.

VI. CONCLUSIONS

Existing method for thermal design of surface condenser does not achieve the HEI method values. An analytical approach is necessary for implementing new method for thermal design of surface condenser to achieve the HEI method values and rated output of turbo generator unit at site.

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