Abstract

The overview of this project is to perform a full heat-balance of a marine steam power plant. A power plant with a Shaft Horse Power of 32,500 SHP will generate a certain kilo-Watt (kW) and will produce a certain flow (m-dot) to the main condenser. My final matrix will show, step-by-step the values of each component in the total heat balance. Also what will be included is a system diagram to provide a visual component to the project. The total heat balance should have an equal heat-in and heat-out.
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Introduction

Steam Plants have been around for over 100 years, and paved the way for modern shipping. Steam plants work by heating water past its boiling point, until it’s superheated, then driving it through multiple turbines to produce electricity and thrust. The Steam-Water Cycle is as follows:

1. Boiler – A boiler contains the heating element of the system; fire generated by burning fuel, and applies it to the medium, water, in order to boil the water.
2. Throttle Box – This is the means to control the output of the boiler. In this project I will be using set values to calculate the heat balance.
3. High Pressure (HP) Turbine – The HP Turbine is where the superheated steam from the boiler is directed to, in order to generate a spinning action of the blades of the turbine. The more nozzles open, the greater the flow, the greater the power.
4. Low Pressure (LP) Turbine – The LP Turbine is where the now less-superheated steam travels through after the HP Turbine.
5. Condenser (Main/Auxiliary) – The Condenser is where the steam is dumped after the LP Turbine. It interacts with a cooling medium (usually Seawater) and heat transfer occurs, cooling the steam into water. In this project, a Low Pressure Condenser will be used (Vacuum).
6. Condensate Pump – The means of pumping the condensed steam through the remainder of the system.
7. Air Ejector – Air Ejectors remove the non-condensable gases from the system and helps to draw and maintain vacuum.
8. First Stage Heater – Heats the water for hotel loads, auxiliary loads, and miscellaneous loads.
9. DC Heater – The DC Heater (aka De-aerating Feed Tank) acts as a holding tank for the incoming water to the boiler, removes non-condensable gas, and heats the water more.
10. Feed Pump – The Feed Pump serves as the driving force of the water into the boiler. Its discharge pressure must be greater than that of the boilers in order to have flow.
11. Economizer – Acts as a reheat to the system so it won’t cause a shock to the system with the entrance of cold water to the boiler

A heat balance is all the calculations required for an engine room. These calculations include the mass flows and enthalpies throughout the plant and at certain times other variables such as temperature and pressure are necessary. The idea is to complete the heat balance with a mass
balance. I will design as if we will not lose anything (heat, water or steam). Essentially, what goes in will theoretically come out.

**Problem Description**

A design requires that the original design characteristics contain a Ships Horse Power (SHP) of 32,500 SHP, a complement of 40 persons, 2 boilers, a throttle temperature of 950 degrees Fahrenheit and pressure of 850 psig. Condenser pressure is 1.5 Inches of Mercury (" Hg) and Auxiliary Condenser is 2" Hg. The required Engine efficiency (Em) is given at 0.96. The objective is to complete the heat balance and flow diagram.

Note: The design must contain a total plant flow (E) for 2 boilers.
Methodology

My plan is to complete a matrix that will lay out the entire heat-balance and also to create a diagram in AutoCAD that illustrates all flows, values, and components. Once I complete the matrix I will have E (Total Energy). All other mass flows will come into play as I go through the matrix.

Once I list out and have all the required calculations needed to work my way through the system, I can begin the heat balance on the plant. The matrix equations are based on control volumes around certain chosen equipment (that is typical for the plant). The sum of the flows in is equal to the sum of the flows out (exiting). Each matrix equation will have its source noted and all values will be labeled.

Based on the information given, I can solve for different components of the project, while being able to set up other sections of the project that required the future data. As I go through this project, I will compare my calculations to similar plants to ensure that my values are real and make sense.
Required Resources

I will need a variety of resources in order to successfully complete this project. First and foremost, I need Microsoft Excel with the “Steam Tables Excel Plug-In”. This will enable me to work with Steam Tables directly and be able to get more accurate values. I will also need Steam Tables, which I have: ASME Steam Tables COMPACT EDITION. I also need a variety of textbooks in order to help me through the Steam Cycle and components of it. I will use my Technical & Research Bulletin 3-1 which has the problem statement and will help walk me through solving each portion of the system. I will also need my Thermodynamics Book, as it will help me with heat exchanges and flow exchanges. I will also be utilizing the online resources (Energetic and engineering analyses of gas turbine based on cogeneration systems), (Steam Turbines), and (Steam Turbine Model) provided by my professor, to help aid in the background formulas, definitions, and descriptions. Lastly, I will utilize Wikipedia.org, as a reference site as it provides helpful information, diagrams and pictures, and resources that could prove vital to supporting my project.
**Outcome**

My expected outcome is a full Matrix of data that will contain all components and values of the heat balance and also a fully-drawn system diagram of the marine-power-plant that I am depicting.
**DEADLINES**

1. Functioning Web Portfolio – 09/16/11
2. Tentative Project Proposal Draft - 09/23/11
3. Project Proposal Draft will brief presentation of proposed work - 09/30/11
4. Finish gathering all required information for all descriptions, calculations, drawings – 10/13/11
5. First Progress Report Due - 10/21/11
6. Finish All Hand Calculations - 10/28/11
7. Second Progress Report Due - 11/11/11
8. Finish Excel spreadsheet – 11/18/11
10. Final Draft Due- 12/02/11
11. Clean up project, all calculations, bind project and all associated data, print pictures - Week of 12/4/11
12. Finish the project – 12/15/11
13. Final Report - 12/16/11
References


