RMS
Rotating Machinery Services, Inc.

EXHAUST HOOD LOSSES IN STEAM TURBINES

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In a condensing steam turbine, the exhaust hood directs the steam from the turbine's last stage blades to the condenser. The condenser changes the phase of the steam to a liquid state, which creates a vacuum that in turn draws more steam from the turbine. This, however, is not the only function of the exhaust hood.

Exhaust hoods are primarily designed to limit the pressure loss and exit energy loss of the steam over the last stage. Any pressure loss at this section of the turbine would noticeably decrease the turbine's thermal efficiency. An ideal exhaust hood should be designed with the largest possible axial size and incorporate smooth turns to decrease the exit energy losses. However, exhaust hoods are frequently limited in their size due to rotor length, the bearing housing and any coupled equipment.

A way to maximize the efficiency of an exhaust hood is with the addition of a diffuser at the hood entrance. A diffuser works by capturing the high steam velocities exiting the turbine and steadily reducing the steam flow to recover as much of its kinetic energy as feasible. By altering the geometry of an exhaust hood with a diffuser, you can effectively decrease the pressure drop and the exit energy losses. Figure 1 depicts the total loss coefficient of a modeled exhaust hood as a function of the dimensionless velocity at its entrance. Line 1 portrays the modeled exhaust hood without a diffuser whereas line 2 portrays the exhaust hood with a diffuser.

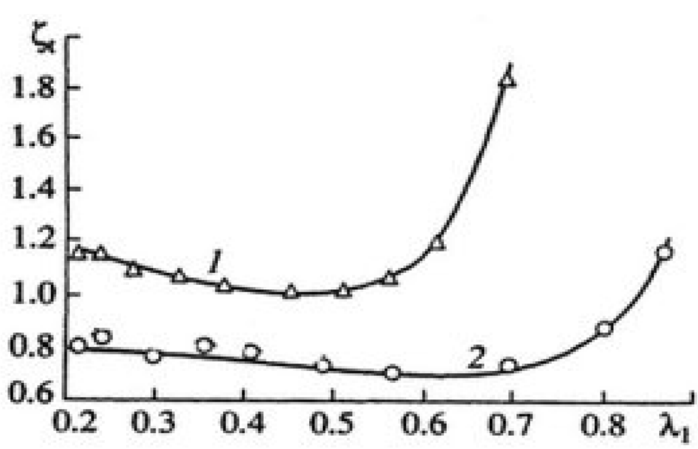

Figure 1: Total loss coefficient vs Velocity at the hood entrance
Source: Steam Turbines for Modern Fossil-Fuel Power Plants

The incorporation of a diffuser comes with its limitations as well. A diffuser is a costly addition to a turbine that also requires extra space. But when turbine efficiency is the primary consideration, typically the benefits outweigh the drawbacks. Figure 2 shows a typical condensing turbine with a traditional exhaust hood design. The smooth curves of the hood redirect the flow downward to the condenser. Figure 3 depicts a high efficiency design with an integral exhaust hood

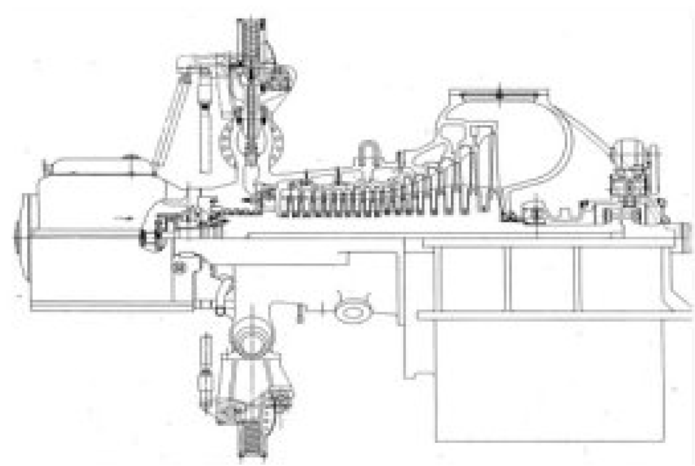

Figure 2: Typical Condensing Turbine with a Traditional Exhaust Hood Design

diffuser. In this case the exhaust is axial immediately following the turbine last stage blades. Since the bearing and shaft end are buried in the exhaust hood, the inlet end is the drive end.

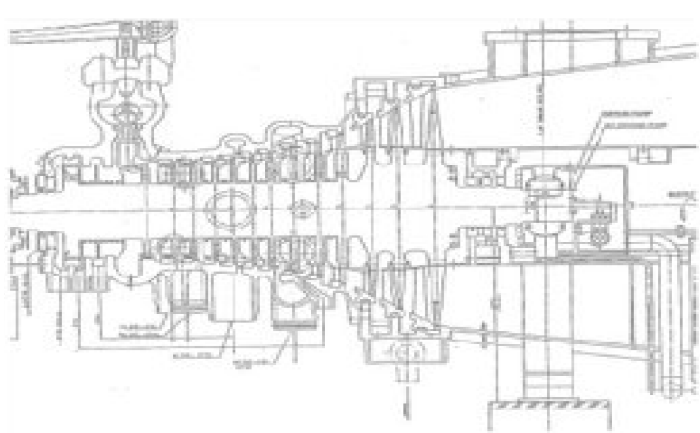

Figure 3: High Efficiency Design with an Integral Exhaust Hood Diffuser

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