Francis Turbine

Components of a typical Francis turbine are shown in figure 1. These usually comprise a volute and

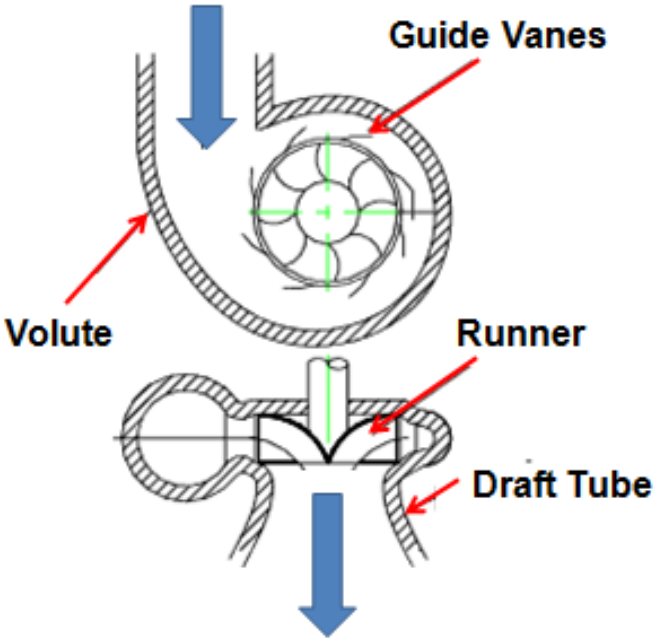

Figure 1: Francis turbine.

guides vanes (often called wicket gates) that add a substantial swirl velocity, v_θ, entering the impeller (or runner) without changing the energy or total head of the inflow. This energy is then converted to mechanical energy during the flow through the impeller or runner and emerges as mechanical energy in the turbine shaft output. Finally the swirling flow discharging from the runner is collected in the draft tube and discharges from the turbine. These components are shown again in figure 2 which also shows the adjustable vanes or wicket gates just upstream of the runner that allow the flow entering the turbine to be adjusted in order to optimize the angle of incidence of the flow entering the impeller. Such control is desirable when the power output of the turbine needs to be adjusted to meet the demand. It should also be noted that the swirling flow entering the draft tube demands careful design of that component in order to maximize the pressure recovery in the draft tube. As will be seen in the next section, the vortex that often occurs in the draft tube is prone to cavitation and/or ventilation which in turn can promote unsteady flows and forces in the draft tube and downstream of the turbine.

Most turbine testing is conducted in large facilities that can accommodate the full scale machinery despite the fact that this often inhibits detailed investigation of the basic fluid mechanics in these machines. An example of such a facility is the turbine test facility pictured in Figure 3.

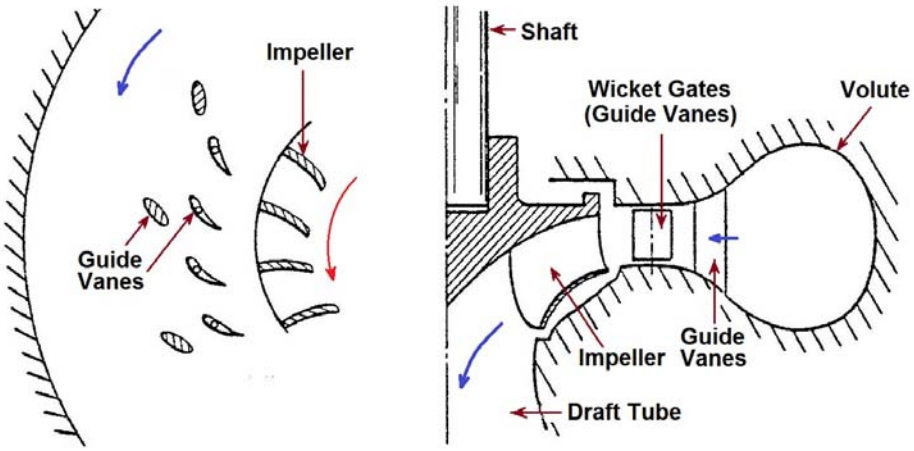

Figure 2: Schematic of a Francis turbine.

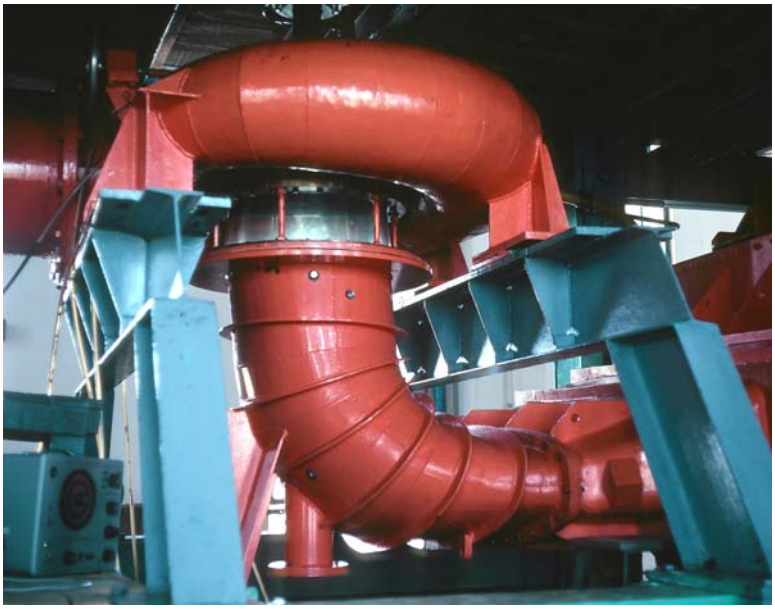

Figure 3: Turbine test facility at the Central Water and Power Research Station (CWPRS) near Pune, India, with a Francis turbine installed.