CHAPTER 9
WELL PUMPS

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9.1 PUMPING GEOTHERMAL FLUIDS

9.1.1 Introduction

Pumping is often necessary in order to bring geothermal fluid to the surface. For direct-use applications, there are primarily two types of production well pumps; (a) lineshaft turbine pumps and (b) submersible pumps - the difference being the location of the driver. In a lineshaft pump, the driver, usually a vertical shaft electric motor, is mounted above the wellhead and drives the pump, which may be located as much as 2,000 ft below the ground surface, by means of a lineshaft. In a submersible pump, the driver (a long, small diameter electric motor) is usually located below the pump itself and drives the pump through a relatively short shaft with a seal section to protect the motor from the well fluid.

Lineshaft pumps have two definite limitations: (a) they must be installed in relatively straight wells and (b) they are economically limited to settings of <=2000 ft. For direct heat applications, the economic setting depth limit is probably closer to 800 ft. (Refer to Chapter 6, 6.3.5 Plumbness and Alignment.) A general comparison of lineshaft and submersible pumps appears below in Table 9.1.

Table 9.1 Comparison of Lineshaft and Submersible Pumps

Lineshaft	Submersible
Pump stage efficiencies of 68 to 78%. Lower head/stage and flow/unit diameter. Higher motor efficiency. Little loss in power cable. Mechanical losses in shaft bearings.	Pump stage efficiencies of 68 to 78%. Generally, higher flow/ unit diameter. Lower motor efficiency--operates in oil at elevated temperature. Higher losses in power cable. Cable at least partially submerged and attached to hot tubing.
Motor, thrust bearing and seal accessible at surface.	Motor, thrust bearings, seal, and power cable in well--less accessible.
Usually lower speed (1,750 rpm or less). Usually lower wear rate.	Usually higher speeds (3,600 rpm). Usually higher wear rate.
Higher temperature capability, up to 400ºF+.	Lower temperature capability but sufficient for most direct heat and some binary power applications, assuming the use of special high-temperature motors.
Shallower settings, 2,000 ft maximum.	Deeper settings. Up to 12,000 ft in oil wells.
Longer installation and pump pull time.	Less installation and pump pull time.
Well must be relatively straight or oversized to accommodate stiff pump and column.	Can be installed in crooked wells up to 4 degrees deviation per 100 ft. Up to 75 degrees off vertical. If it can be cased, it can be pumped.
Impeller position must be adjusted at initial startup.	Impeller position set.
Generally lower purchase price at direct use temperatures and depths	Generally higher purchase price at direct use temperatures and depths.