

TECHNICAL MEMORANDUM

12 January 2012

TO: FILE NOTE
FROM: ALEX DOLL, ALEX G DOLL CONSULTING LTD.
SUBJECT: MILL MOTOR POWER DEFINITIONS

Summary:

Grinding circuit power is commonly used as a defining parameter in circuit design and analysis. However, the circuit power can be defined at a number of points, and depending upon the use of the power, different system losses must be applied to the power reported.

Discussion:

Per the diagram on the following page, the specification of mill power differs depending upon what the definition is to be used for. Operating costs are measured at the utility connection or at the power station, and include all the system losses between the mill and that point.

The sizing methods for grinding mills also differ on the definition of where a mill's power is specified. The Bond work index methods, such as DJB Consultants, and Minnovex CEET methods both specify power "at the mill shell" (also referred to as "power at the pinion"). The JK SimMet calculation specifies power measured by the motor input (based on a Morrell power model, usually corrected to the motor input). The indication on the plant's distributed control system (DCS) is typically tapped from the MCC room or electrical house, though it may be 'corrected' mathematically to another position, such as the motor input.

The nature of the mill motor affects the level of power losses between the different components. Gearless motors have no loss-generating mechanical connections between the motor output and the mill shell (the mill shell is actually the motor's rotor), so it has 100% efficiency in transmitting motor output to the mill shell. Synchronous motors have 98.5% efficiency in converting motor output to power at the mill shell due to the pinion and gear. Wound rotor motors with gearbox reducers have a 98.5% gearbox efficiency and 98.5% pinion efficiency resulting in an overall 97% efficiency converting motor output to power at the mill shell.

Losses are multiplied to derive total losses. For example, converting a gearless motor mill shell power to DCS power requires an overall efficiency of $1.0 \times 0.97 \times 0.98 = 0.951$. Thus, a gearless motor applying 20 MW of power to the mill shell will indicate 21.04 MW of power at the DCS. Operating the motor for one hour would consume 21.68 MW·h of power from the supply assuming a 1.0 power factor ($1.0 \times 0.97 \times 0.98 \times 0.99 \times 0.98 \times 1.0 = 0.922$ overall losses).

Financial calculations should be based on the combined losses up to the "Power from supply" connection point. Thus, the operating cost should be based on the DCS power reading divided by 0.970. For a mill sized based on the power at the shell, the operating costs should be based on the shell power divided by 0.922 for gearless, 0.908 for fixed-speed synchronous and 0.895 for fixed-speed wound rotor motors with reducers.

Credits & Comments:

Losses are based on values derived by Mac Brodie P.Eng and Derek Barratt P.Eng. JK power reading position by Mark Richardson (Contract Support Services) and Guillaume Chiasson (SGS Lakefield).

Values are provided as "typical". Losses are also affected by factors such as conductor length, conductor thickness, altitude, presence of step-down transformers and power factor corrections.

Diagram:

