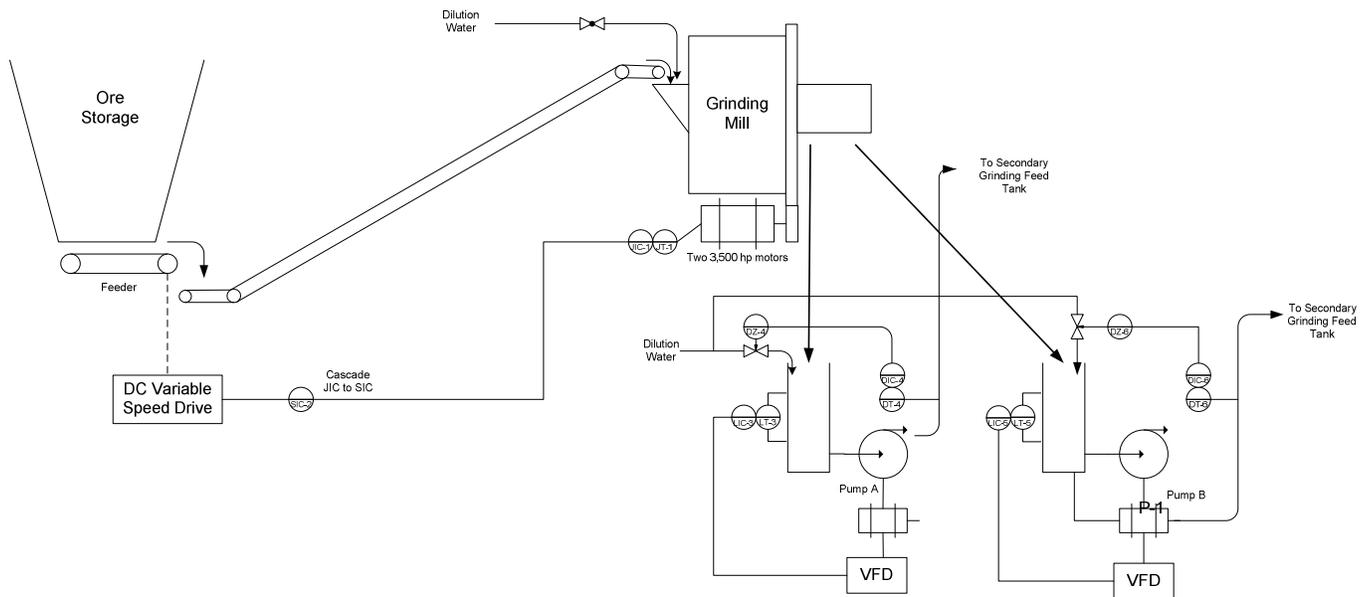


## Grinding Mill Control

The primary grinding stage at a taconite plant on Minnesota's Mesabi Range consists of ten wet grinding mills, each 26' in diameter and 16' long. Each mill is driven by two 3,500 hp wound rotor induction motors. Maximum production through each mill is limited by the ratings of the induction drive motors. The power draw for the motors is controlled by adjusting the feed rate to the mill through a variable speed bed feeder. However, the existing control system was unreliable and operators frequently controlled the feeders manually, resulting in wide excursions in the power draw on each mill. Low power draw results in unrealized production; excessive power draw causes accelerated motor wear and the risk of premature failure.



I developed a new control system after consulting with plant managers and operators. After reviewing available off-the-shelf control products, and viewing installations at other plants, a distributed control system was selected. The system is based on an eight-loop self-contained controller. One controller was installed on each of the ten grinding mills. The ten individual controllers communicated back to a central control console where the performance of all ten mills could be monitored through video displays and adjusted as necessary. Configuration (i.e. programming) and tuning could be accomplished either at the individual controller through a built-in keypad and display, or from the central control console.

To prepare for the installation of the system I generated detailed schematic diagrams for each control loop and wiring diagrams. These drawings were

reviewed with electrical maintenance personnel (foremen as well as electricians) to ensure the drawings contained the necessary information, as well as clarity, to ensure smooth installation, startup, and ongoing maintenance.

Initially, management was concerned with the concept of a digitally based controller controlling all parameters of a mill. To address these concerns, I designed the installation for the first mill to include a set of control relays operated by a master switch. The master switch selected between "ANALOG" and "DIGIAL" control modes. With the switch in the ANALOG position, the mill would be controlled from the existing inferior controllers. Although inferior, the operators were familiar and comfortable with the old system. With the master switch in the DIGITAL position, all sensors and actuators were transferred to the new control system.

Initial installation and startup on the first mill went smooth. I spent time with each shift operator to demonstrate the use of the new control system, answering their questions and ensuring they were comfortable with both the controller and the central control console. A decision was quickly made to eliminate the additional burden of the relays on mills 2 through 10. As additional mills were converted to the new digital control scheme, the operators came to enjoy the use of the central control console where they could see the operation of all ten mills at a single glance.

Twenty-five years later, this control system was still in use at the taconite plant.