The control and measuring instruments of this furnace collect and convert signals for a computer, which then processes and analyzes the signals and shows the results of the analysis on a display.

The control and measuring instruments of a blast furnace collect operational data and convert the signals conveying that information into a form suitable for use by computers. The latter then process the information, analyze it, and show the results of the analysis on a display. A 4–20 mA digital signal is used as the output signal. The pressure gages used in the instrumentation system are installed at sampling points located immediately behind stop cocks. The instruments that measure the static pressure gradients are placed in separate cabinets located as close as possible to the sampling points. The cabinets may also be placed in the control room, which should be as close to the furnace as possible in order to minimize signal losses. The temperature gages are installed in the heads of thermometers. Most of the transducers that are used are readily programmable, which reduces the number of spare parts needed and makes it possible to easily change the measurement range. Water flow rate is measured using induction pickups, due to their low sensitivity to pollutants in the water. Such instruments do not have any effect on the pressure losses in the system. The flow rates of steam, compressed air, and certain other gases encountered in the blast-furnace shop are measured with the use of flowmeters that obtain measurements based on turbulence in the flow. Fluid levels are measured using differential level gages. All the rooms that house control and measuring instruments (CMI) and the external cabinets that contain transducers are connected to a power source (220 V, 50 Hz) of suitable capacity. The power sources (24 V) for the transducers and other sensors are located either in separate control rooms or in cabinets situated so as to evenly distribute the electrical load.

The weigh hoppers are connected to an overlying computer by an RS 485 serial interface.

The following parameters are monitored on the blast furnace by means of the CMI data:

- **the cold combination blast:** temperature, pressure, discharge to the blast furnace, volume released to the smokestack, moisture content, oxygen content, position of the snort valve;
- **the hot combination blast:** pressure, temperature;
- **the shell and the furnace lining:** temperature of the furnace’s foundation, the air-cooling system of the bottom, the hearth lining, the hearth portion of the shell in the notch region, and the portions of the lining in the bosh and the shaft (Fig. 1);
- **the top equipment (bell-less charging apparatus):** the pressure drop between the hopper and the top of the furnace, the temperature of the reduction gear, the discharge of the coolant for the gear, the discharge of the coolant for the lower gas-cutoff valves, the stockline level, and the time needed to tilt the hopper in order to measure the profile...
of the surface of the stock. The last-mentioned parameter is measured using a radiation profilometer located on
the top platform of the furnace. This instrument plots curves of the profile, establishes the outline of the surface
of the stock, and determines the rate at which the charge is descending inside the furnace. A computer mathemat-
ically analyzes the data on the stock surface and depicts the results in graphical form. Thus, it becomes possible
to optimize control of the smelting operation.

The following parameters of the blast-furnace gas are monitored in the flue system: the temperature of the gas in
the flues, gas temperature in the top of the furnace, static pressure gradients, and gas pressure in the top. The composition
of the top gas is also analyzed. The analyzers that are used continuously determine the contents of CO, CO₂, and H₂ in the
top gas. This information is necessary to control the operation of the furnace. All the analyzers operate simultaneously in
the on-line mode on one sample of gas. The sample is collected by two probes with excess pressure in the flue system.
One is the working probe, while the other probe is held in reserve and is periodically cleaned and calibrated by injecting
nitrogen through it. The control system provides for automatic calibration of all the analyzers, checks the instruments for
errors, turns the probes on and off as necessary, and also controls the other operations performed by analyzers. The cali-

394