Colorado Fuel and Iron Corporation's Basic Oxygen Steelmaking Plant

By George Grosvenor

As early as 1955, the Colorado Fuel and Iron Corporation considered the basic oxygen furnace process of manufacturing steel as a means of additional capacity required for the plant at Pueblo, Colorado. At that time, however, the process had not progressed to the point of meeting the grades of steel necessary to satisfy customers' needs. The result was the building of an additional open hearth furnace in the existing 16-furnace shop.

Since completion of the new open hearth furnace, great strides have been made with the basic oxygen process. Two very important improvements that affect CF&I are: (1) the ability to use additional amounts of scrap in the charge, and (2) the ability to tap heats in a wide range of carbon (0.05 to 1.00 pct) necessary in the business.

In 1959, the decision to build a basic oxygen furnace shop was made. It was to have an ingot capacity of 50,000 net tons per month. Planning was started immediately for the engineering and construction of such a shop.

At the same time, experiments were under way to increase tonnages of hot metal from the plant's four blast furnaces by approximately 15 pct. This would mean producing a total of 110,000 net tons of hot metal per month. The additional iron will serve to replace some of the iron the open hearth must give up to the basic oxygen furnace shop.

Present plans anticipate 100,000 net tons of steel to be produced in the open hearth and 50,000 net tons of steel to be produced at the basic oxygen furnace shop each month. Products of the Pueblo plant of CF&I range from low-carbon rimmed steel (0.05 pct max) for wire, through intermediate carbon grades (0.30 to 0.50 pct) for seamless tube steel, to high-carbon (0.60 to 1.00 pct) for rails, fastenings, and grader blades. Inasmuch as scheduling of the two blooming mills requires the full range of steel continually, both the open hearth and basic oxygen furnace shop will be required to produce them.

The basic oxygen furnace shop is typical in that it consists primarily of a scrap aisle, charging aisle, furnace aisle, and teeming aisle. It will be a two-furnace shop, one operating and the other being relined or on stand-by. Size of the furnace shell is 18 ft 6 in. i.d., and 27 ft high; with a volume of 2810 cu ft after lining, to produce a nominal heat size of 100 net tons. Charging of scrap will be accomplished with a Calderon charger, which is capable of charging the furnace in 30 sec with approximately 22 tons of light scrap (45 lb per cu ft). After the hot metal is added, the blowing of oxygen proceeds at a rate of 8000 to 10,000 cfm. Tap to tap time should be less than one hour.

Dry type electrostatic precipitators will be employed to remove solids from the flue gas, and a pugmill is to be used to remove dust from the precipitator hoppers.

Teeming practices will be the same as those presently employed in the open hearth shop.

Dimensions of the building are: scrap aisle crane runway, 65 ft wide by 100 ft long; charging aisle, 65 ft wide by 400 ft long; furnace aisle, 40 ft wide by 500 ft long; teeming aisle, 65 ft wide by 500 ft long. The teeming table area will be capable of handling four 125-ton heats.

Equipment consists of one 15-ton crane for handling scrap; one 125-ton crane in the charging aisle; and one 125-ton crane in the teeming aisle. Three 7000-lb fork trucks with rotary heads will be used to handle alloys and refractories. Car pullers will be used to move blast furnace torpedo cars. A rubber-tired car mover will be used to move scrap and flux cars. An 8-ton elevator south of the furnaces will be incorporated to handle spare parts, refractories, and lift trucks to the various levels. An enclosed rubber belt conveyor system will handle fluxes from the dumping station to the day bins and then to the furnace hoppers. Transfer cars for the teeming ladle and slag pot are capable of working in tandem, using power from only one of them.

Initially, eight 100-ton teeming ladles and 20 slag pots of 260 cu ft capacity will be available for use in the shop. Present slag-handling methods used in the open hearth will be incorporated in the new shop. Ladle repair and relining will be done in the central repair shop, which services the open hearth also.

Water supply will consist of a combination of "primary" and recirculated water. It will be received under 80 psi and raised to 150 psi for lance cooling at the rate of 250 gpm. Hood cooling water will be used at 80 psi and then re-pumped for spray water at 50 psi.

The fan capacity is rated at 300,000 cfm at 350°F. A 700-hp motor will drive the fan. It will "pull" 10 in. of water at the precipitator header.

The normal complement of controls and indicators will be incorporated for water temperatures and pressures; oxygen pressure; lance clamping; flue gas temperature; automatic flux batching system; hot metal and bath temperatures; and steel sampling.

A plan view of the shop shown in Fig 1 indicates the location of the flux unloading hopper where carloads or truckloads of burnt lime, fluorspar, mill scale, and ore are dumped. Belt conveyors lift the materials to the five 4000-cu-ft day bins and a batch hopper with a capacity of 480 cu ft. The hot-metal station can handle two torpedo cars at a time. The scrap aisle trackage can handle 30 cars, including 6 under the crane. A standard gauge track into the south end of the building will be used to unload refractories, alloys, and spare parts onto the dock and storage area. The elevator is accessible from either the north or south side for ease in loading and unloading at the various levels.

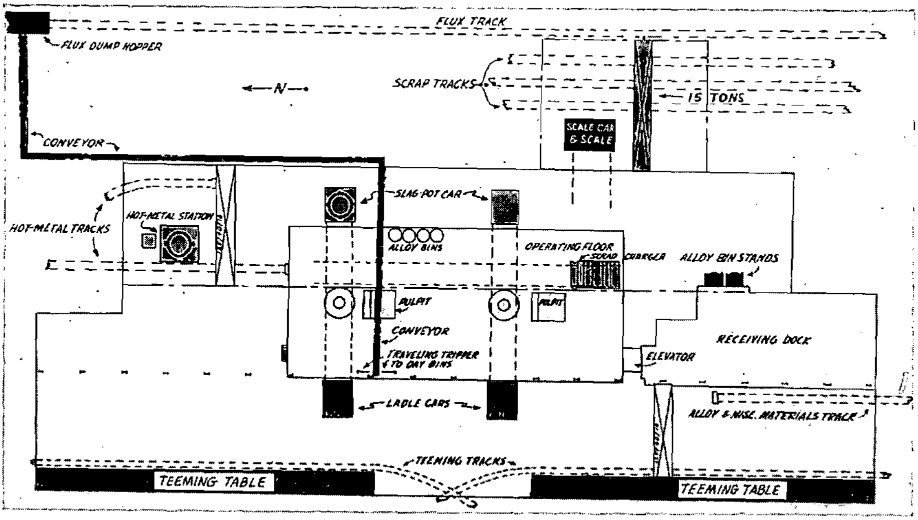

Fig 1—Plan view of the basic oxygen steel plant.

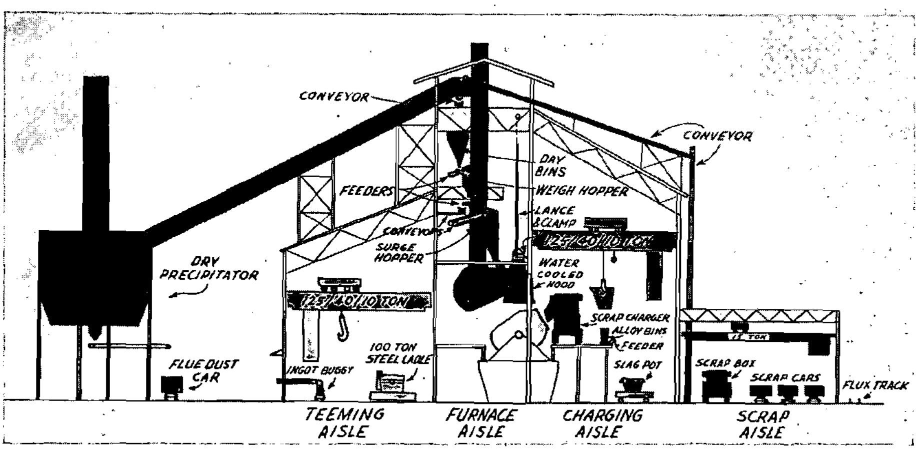

Fig 2—Cross section of basic oxygen steel plant.

Ladle setup will be accomplished in the teeming aisle area between the furnaces on ladle stands that are able to rotate 180 deg to dump slag and debris. Slag pots will be loaded onto low-boy trucks at either end of the charging aisle.

Figs 2 and 3 show cross sections of the basic oxygen plant. The total height of the building is 166 ft.

Combined service operations for both the open hearth and basic oxygen furnace shop will include ladle relining, stopper making, mold preparation, hot-top preparation, narrow-gauge transportation, ingot stripper and storage yard, scrap preparation, and necessary clerical help for ordering supplies and materials.

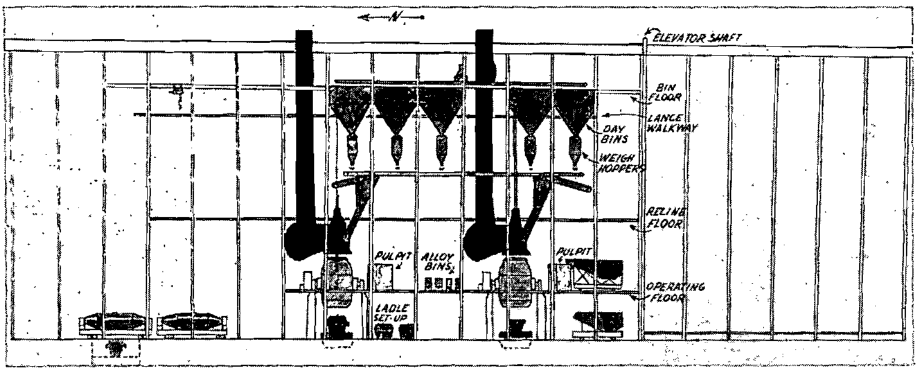

Fig 3—Cross section of basic oxygen steel plant.

The oxygen plant is outside the plant and will furnish 280 net tons per day with a line pressure of 185 psi. Storage facilities are: liquid equivalent of 10,000,000 cu ft and a gaseous surge of 200,000 cu ft.

Discussion

D. M. McFarlane, Chairman—Are there any questions for Mr. Grosvenor?

A. I. Gorman—Mr. Grosvenor slipped rather quickly over one phase of the operation, which I am sure is interesting everyone. How well do you control your intermediate and high-carbon grades?

George Grosvenor—Well, sometimes not close enough to meet the specifications, if that is what you mean. We are not yet operating the basic oxygen furnace.

A. I. Gorman—This is all still in the future?

George Grosvenor—This is all in the future.

A. I. Gorman—Started in 1959?

George Grosvenor—Maybe I left out a little. We are not expecting to get started before about June the first on our basic oxygen shop.

A. I. Gorman—My question took in a little earlier.

George Grosvenor—Our future is spotless; so is our past, at this time.

D. M. McFarlane, Chairman—In answer to the question, I think Roy Conway, down here from Algoma, can answer that.

T. R. Conway—Actually, as far as heats coming in, 75 pct of all grades tapped up to 1 pct carbon are coming in at the turndown.

D. M. McFarlane, Chairman—If Mr. Benton had been here, he would have told us 95 pct!

C. C. Benton—Well, 75 pct is correct. For clarification, approximately 100 lb of carbon per ton of ingots is used to put the heat in specification on all heats over 0.30 pct carbon at Algoma.

F. R. Smith—Mr. Grosvenor, you said you were going to make a heat in 45 minutes?

George Grosvenor—We hope to.

F. R. Smith—How fast will your people pour that heat?

George Grosvenor—Probably 125 tons in about 30 minutes.

F. R. Smith—And you have one ladle crane?

George Grosvenor—Right.

F. R. Smith—You have to dump the slag with that crane sometimes?

George Grosvenor—We will dump the slag and set it on the stand, and all the rest of the ladle work will be done on a ladle stand, on which we can dump out sculling slag.

F. R. Smith—Are you anticipating any major delays because of having only one crane in each area?

George Grosvenor—I should like to say No, but I am sure we are starting this way, probably, because of finances. We are going to start with one crane in both aisles but, if we feel that it is delaying us or getting to the point where it slows up the work, we can add another crane.

F. R. Smith—What is the yearly capacity anticipated?

George Grosvenor—About 600,000 a year, which is on the low side.

D. M. McFarlane, Chairman—Thank you, gentlemen. Our next speaker is John Glasgow, Open Hearth Superintendent, Jones and Laughlin, Cleveland, Ohio. When we first started this operation, we had 38-ton furnaces. Now Mr. Glasgow will tell you about 250-ton furnaces. Mr. Glasgow.

J. A. Glasgow—Mr. Chairman, our furnaces are 200-ton units.

I was glad I got on the program before our friend Dick Morgan from Great Lakes, because I plan to talk about the biggest oxygen furnaces in the world.