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CONFIDENTIAL

DEPARTMENT OF JUSTICE
WAR DIVISION
ECONOMIC WARFARE SECTION

CONFIDENTIAL REPORT ON

HONKEIKO STEEL WORKS, PENHSIHU, MANCHURIA

Iron Works, Coal and Ore Mines, and
Proposed Steel Works

April 20, 1943

Submitted by: Leo H. Kuhn
Economic Warfare Section
Department of Justice
Chicago, Illinois

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Economic Warfare Section
War Division
Department of Justice
Washington, D. C.

Confidential Report
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Re: Honkeiko Steel Works, Penhsihu, Manchuria--Iron Works, Coal and Ore Mines, and Proposed Steel Works
Submitted by: Leo H. Kuhn
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I. INTRODUCTION

The Honkeiko Steel Works at Penhsihu is the only producer in Manchuria of high quality low phosphorus pig iron necessary for the manufacture of high-grade and special steels. The 1941 capacity of this plant was 660,000 metric tons, which is over 20 percent of Japan's total production of this high-grade pig iron.

The Japanese are desperately short of special and alloy steels for aircraft parts, machine tools, ball bearings, etc. (See Confidential Report on the Japanese High-Speed Drill Industry dated December 12, 1942, by Robert A. Nitschke; also Addendum, dated April 16, 1943.) The Japanese are also desperately in need of the high-grade pig iron necessary in the manufacture of such steel. They have no reserves of such pig iron and it is the opinion of informants that they have no stockpile of scrap to substiture for high-grade pig iron because all United States imports were currently consumed. Informants consider Honkeiko to be of equal, if not greater, importance to the Japanese war economy than the Showa Steel Works. (See Confidential Report on Showa Steel Works dated March 15, 1943, by Leo H. Kuhn.)

Since 1937, with the placing of Penhsihu properties under the control of the Manchurian Industrial Development Company, the Japanese have made every effort to expand production of pig iron and also to develop steel ingot production. By late 1940, orders for open hearth equipment were placed and it is known that in November 1942 the Japanese were negotiating with the Germans for the purchase of rolling mill equipment to be used at Honkeiko.

The town of Penhsihu is a naturally superb location for the development of iron and steel manufacture. The surrounding mountains contain not only the richest iron ore in Manchuria (averaging 64% Fe) but also large quantities of fine coking coal and limitless limestone deposits.

II. HISTORY OF THE COMPANY

The Honkeiko Steel Works is now a subsidiary of the Manchuria Industrial Development Corporation. This steel works has been known by various names including Penhsihu Coal & Iron Company, Penhsihu Iron and Colliery Co., and The Honkeiko Iron Works. It is known that the Penhsihu iron mine was worked by the Manchukuoans as early as the year 1833. As a result of the Russo-Japanese war during 1904-1905, the Japanese acquired the mining and mineral rights to this area and commenced development through the South Manchuria Railway, who built a small 25 or 50 metric ton blast furnace.

In 1910 the Honkeiko Baitetsu Co., Ltd. was established with a capitalization of 10,000 yen. The capital stock was fully paid. One hundred twenty

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shares was owned by the Okura family, one of the wealthiest and most powerful in Japan, and 80 shares was owned in the name of the Minister of Finance and Commerce of Manchuria. About this time an additional blast furnace of 200 metric ton capacity was built for the production of pig iron. In 1925 a modern blast furnace of 250 ton capacity was built, and again in 1927, another blast furnace of 350 ton capacity was built, which replaced the old 200 ton capacity furnace.

The iron works continued in operation under the joint supervision of the Japanese and Chinese until the Kwantung Army (Manchuria government) expropriated all heavy industry in Manchuria and formed a state monopoly which it called the Manchuria Industries Development Corporation, frequently referred to as "Mangyo."

Since October of 1937, the coal and iron works at Penhsihu have been operated by the aggressive and enterprising "Mangyo" organization, and an ambitious program of expansion has been undertaken. By 1940, blast furnaces and coke ovens for a new pig iron plant had been installed. Plans were also drawn up for a steel mill with open hearth furnaces, gas produce plant, and rolling mill. Some of the equipment for this proposed plant was ordered in Japan in 1941 and as late as November 1942 negotiations for rolling mill equipment were carried on between the Japanese and the Germans.

III. PRODUCTION AND CAPACITY

As of the latter part of 1941, the pig iron capacity of Honkeiko was approximately 660,000 metric tons. The two old blast furnaces in the Number 1 plant have a capacity of approximately 180,000 metric tons a year. Actual production in metric tons of the Number 1 plant for the years 1930 to 1936 was as follows:

86,421
65,620
81,057
115,950
153,450
151,100
160,439

The two new furnaces in plant Number 2 have a capacity of 480,000 metric tons a year. It is believed that the Number 2 plant was producing pig iron by the end of 1941. The pig iron produced has a phosphorus content of .04 and is highly adaptable for making high grade quality steel and steel alloys.

Honkeiko also had a coke oven capacity sufficient to take care of the needs of its blast furnaces. This capacity has been estimated at approximately 2060 metric tons per day. In 1941 a coke by-products plant was being constructed. Based on the coke oven capacity at the new plant it is estimated that a by-products production of approximately 7,000 gallons of benzol, 24,000 gallons of tar, and 56,000 pounds of ammonium sulphate per day would be realized.

In 1938 the Japanese began plans for the construction of a steel works at Honkeiko. As of 1941 no ground had been broken for this proposed plant but equipment had been ordered. This proposed plant if completed would have a capacity of 600,000 metric tons of steel ingots per year.

IV. RAW MATERIALS

Penhsihu is the ideal location for any steel works. In the immediate vicinity are large deposits of coal, rich ore mines, and high quality limestone quarries. So abundant are these materials that they not only supply the Honkeiko works but large quantities of coal and ore have been shipped to Showa and to Japan itself. The coal, iron, and limestone resources are described in more detail below.

A. The Penhsihu Coal Mines

Large deposits of coal exist in the hills surrounding the two plants of the Honkeiko Steel Works. It has been estimated that these mines contain a reserve of approximately 22,000,000 metric tons of rich coal and 200,000,000 metric tons of low-grade coal. Production in 1936 reached 739,000 metric tons. The principal coal mine is located approximately 1-1/2 miles west of the No. 2 Honkeiko plant. This is a slope type mine and is connected by private railroad to the Mukden-Antung Railroad as shown on Exhibits No. 1 and No. 8.

An analysis of the rich unwashed coal shows the following:

Water	Ashes	Vol. Matter	Vol. Carbon	C	H_2	O_2	N
0.38	17.36	21.04	61.60	70.91	4.13	5.00	1.41

Const.		Non const.	
S	All S	S	All S
1.19	1.36	0.17	69.29

Because of its expanding nature this coal must be mixed with a high volatile coal to secure a proper coking mixture. Nevertheless, it is reputed to be the best quality coking coal in Manchuria. Tests made at the Bureau of Mines laboratory in 1929 on four samples of Penhsihu coal disclosed the following per metric ton of dry coal:

Raw coal ash--%.	26.2
Washed coal ash--%	10.4
Washed coal recovery--%	54.7
Furnace coke--%	78.5
Small coke and braise--%	4.2
Total coke--%	82.7
Furnace coke from raw coal--%.	42.9
Coke ash--%	12.6
Gas--cubic feet	11,800
Gas for ovens, cubic feet	6,000
Surplus gas, cubic feet	5,800
Gas for ovens--%	50.8
Surplus gas--%	49.2

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By-product expectancies per metric ton of dry Penhsihu coal are as follows:

Sulphate--kgs.	9.8
Light oils--gal.	1.8
Tar--gal.	8.2

B. Myojiko Ore Mine

The Myojiko iron ore mine is located about 30 kilometers northeast of the Honkeiko Plant Number 1. It has an estimated reserve of 5,000,000 tons of rich ore which is regarded as equal or better than the finest in Manchuria and 300,000,000 tons of lean ore. Tests of the rich ore show from 68.09 per cent to 70.69 per cent Fe.; .24 per cent to .28 per cent manganese; .02 to .015 per cent sulphur; .02 per cent phosphorus; and .3 to 1.3 per cent water. The lean ore averages 34.5 to 37.78 per cent Fe.; .13 to .17 per cent manganese; .005 to .049 per cent sulphur; and .40 to .55 per cent water. This mine is owned and operated by the Honkeiko plant and is served by a railroad connected with the Mukden-Antung lines.

C. Limestone

Limestone of good quality and unlimited supply is found throughout Penhsihu and the surrounding mountains. Several limestone quarries are located as shown on Exhibit No. 1.

V. DESCRIPTION OF THE WORKS

A. Location

The town of Penhsihu is located on the Mukden-Antung Railway 77 kilometers southeast of Mukden and 200 kilometers northwest of Antung. The original town was located in a narrow valley between the two mountains through which ran the South Manchuria Railway line. During 1938 the official population of the city was 66,394, of which 5,243 were Japanese. This population has undoubtedly increased since that time.

Southwest of the railroad tracks opposite the city and beyond a small creek flowing into the Taishi River is located the Number 1 plant of the Honkeiko Steel Works, frequently referred to as the "old plant." This plant covers an area of approximately 50 acres. An outstanding landmark is the monument of Baron Okura located on top of the mountain north of the plant. The Number 2 or new plant of the Honkeiko Steel Works is built along the banks of the Taishi River and is served by the steel works' private railroad which connects the coal mine with the Mukden-Antung Railway. The Number 2 plant is about 6 kilometers from the old city and is located on the only flat land in the vicinity. This plant site covers approximately 500 acres. The new city pf Penhsihu is built north of the new plant on the opposite side of the Mukden-Antung Railway tracks.

Exhibits No. 1 and 8 are diagrams of the city of Penhsihu showing locations of the various buildings of the steel works and the surrounding area. Exhibit No. 2 is a photograph of the Honkeiko Steel Works taken in 1938. Exhibit No. 6 is a photograph of the Mukden-Antung Railway bridge crossing the

Taishi River. At this point the river is approximately 700 feet wide. Exhibit No. 7 is a photograph of the old city of Penhsihu.

B. Buildings and Equipment

The various facilities comprising the old plant, the new plant, and the proposed steel mill are described below:

1. Plant No. 1

(a) Briquet and Sintering Plant

In this plant the iron ore is crushed, sintered, and briquetted prior to use in the blast furnaces. The capacity of the plant is adequate to supply the needs of the blast furnaces. It is located adjacent to and south of the blast furnaces and is marked "A" on Exhibit No. 1.

(b) Blast Furnaces

The old plant, sometimes referred to as the "No. 1 Plant" had two blast furnaces. The No. 1 blast furnace was built in the year 1925, and is rated at 250 metric tons capacity. The No. 2 blast furnace was built in 1927 and it has a rating of 350 metric tons capacity. The capacity of these two blast furnaces is rated at approximately 180,000 tons of pig iron per year. The two blast furnaces of Plant No. 1 are marked "C" on Exhibit No. 1.

(c) Gas Cleaning Plant

A gas cleaning plant is located in the small brick building between the blast furnaces, as shown on Exhibit No. 1. It is believed that Theisen disintegrators are used for removing the gas from the blast furnaces and cleaning same for re-use as fuel. As late as the spring of 1941 the facilities available for the storage of this gas were very limited.

(d) Coke Ovens

The coke ovens are arranged in a battery adjacent to and west of the No. 1 blast furnace, and are marked "B" on Exhibit No. 1. The capacity of these ovens is estimated at 460 metric tons daily, and they supply the needs of the two blast furnaces. As late as 1941, no facilities were available at this plant for reclaiming by-products.

(e) Pig Casting Plant

The pig casting plant, with sufficient capacity to handle the production of the No. 1 and No. 2 blast furnaces, is located in the vicinity of the blast furnaces.

(f) Small Iron Castings Foundry

A foundry for manufacturing small iron castings and cast iron pipe is located in two small buildings east of the blast furnaces, and are marked "F" on Exhibit No. 1.

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(g) Brick Plant

A brick plant and a group of kilns are located at the southern end of the plant and are marked "R" on Exhibit No. 1. The bricks from this plant are manufactured from the slag which is removed from the blast furnaces and from cement purchased from the Penhsihu Cement Company's plant located a short distance away to the southeast of the No. 1 plant.

(h) Flue Dust Briquet Plant

The blast furnace flue dust is reclaimed and mixed with tar in one of the small buildings of the old plant. This mixture is briquetted and dried for use as fuel in the blast furnace. It is believed that primitive methods are used.

2. Plant No. 2

(a) Blast Furnaces

There are two German-type DeMag blast furnaces at the new plant, each having a rated capacity of 800 metric tons. The total capacity of these two blast furnaces, based on 300 days' operation a year, is estimated at 480,000 metric tons.

(b) Gas Cleaning Plant

Theisen disintegrators are used for cleaning the gas and removing it from the blast furnaces. After the gas is cleaned, it is stored in a large storage tank, similar to those used in the United States for city gas, until ready to be re-used for fuel. The location of this gas storage tank is believed to be as shown on Exhibit 8, between the coke plant and the blast furnaces. It would be easily identifiable from the air.

(c) Pig Castings Plant

A pig casting plant was built in the vicinity of these two blast furnaces to handle their output.

(d) Coke Ovens

About 150 Otto ovens are arranged in two batteries in the coke plant, with a capacity of 1600 metric tons daily. It is believed that the Japanese reclaim and use the coke oven gas. The coke is loaded at the coking docks into charging buckets and hauled over a circular track to the blast furnace charging bins, as shown on Exhibit No. 1. There are two large stacks in the coke oven plant, and the smoke and fire emanating from these stacks would be very noticeable at night. The entire coke plant occupies an area east of the private railroad extending between the coal mine and the Mukden-Antung Railroad. It is located northeast of the railroad bridge crossing the Taishi River. This new railroad bridge is shown on both Exhibits No. 1 and No. 8.

(e) Coke By-Products Plant

In 1941 the Japanese were making strenuous efforts to build a coke by-products plant for Honkeiko. This plant is now believed to be in operation.

Principal products to be secured from this plant were motor benzol, ammonia sulphate, and tar. The secondary objective was to manufacture naphthalene, pitch, creosote, and possibly toluol and xylol. It is estimated that a coke plant at Honkeiko of 1600 metric tons per day capacity would produce as by-products 7,350 gallons of benzol, 24,500 gallons of tar, and 56,350 pounds of ammonia sulphate.

3. Administration Building and Research Laboratory

In the old plant on the south side of the Mukden-Antung Railroad, diagonally opposite the railroad station, was located a large building containing the administrative and engineering offices as well as a modern research laboratory. This building is marked "X" on Exhibit No. 1.

4. Proposed Steel Works

In 1938 the Japanese made plans for the construction of a steel mill to be erected north of the private railroad opposite the coke ovens and blast furnaces of Plant No. 2, as shown on Exhibits No. 1 and No. 8. This plant was to include an open hearth furnace with a capacity of 600,000 metric tons of steel ingots per year, a gas producer plant with capacity to gasify 6,000 pounds of coal per hour, and a rolling mill.

During the year 1938, drawings and specifications for this plant were completed and bids were invited through the Okura Company of Japan. The general plan of the proposed steel plant and rolling mill is attached as Exhibits No. 4 and No. 5. In 1941 no ground had yet been broken on the plant site, although at that time it was reported that the equipment for the same was being manufactured in Japan, and some of it on order in Germany. It is believed that equipment for the open hearth department probably has been supplied from the Japanese manufacturers, and that the furnaces probably have now been completed and are in operation. However, it is not believed that the Japanese have been able to manufacture the rolling mill machinery and equipment and that unless they have been able to secure this equipment from Germany through the blockade, the proposed rolling mill department has not been completed.*

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* On November 17, 1942 a German firm submitted the following proposal for the Honkeiko steel works extension:

(i) Two-high INGOT and SLAB ROLLING MILL.
(ii) Continuous wide sheets universal ROLLING MILL with one preliminary and finishing mill.
(iii) A medium sheet MILL with preliminary and finishing mill.
(iv) An INGOT MILL.
(v) BILLET MILL.
(vi) PROFILE ROLLING MILL.
(vii) INTERMEDIATE ROLLING MILL to relieve pressure on blooming mill and supply billet and profile mills.
(viii) WIRE ROD MILL.
(ix) FIVE SHEET KONTI MILL with preliminary and finishing mill and cooling bed.

A request was also made that the intended layout be wirelessed so the German proposals could allow for further alterations and additions.

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Specifications for the proposed steel plant are described hereafter:

(a) Open Hearth Department

The buildings housing the open hearth plant were to be made of structural steel, the siding to be of 20-gauge corrugated galvanized sheet steel, and the roofing to be of 18-gauge corrugated galvanized sheet steel. Exhibit No. 9 attached hereto is a drawing of the proposed open hearth building, prepared by the H. A. Brassert Company in accordance with the specifications.

The specifications state that wherever possible, the equipment should be made for the use of alternating 50-cycle, 400 volt, 3 phase electric current. The equipment specified for the open hearth plant is described in detail in Appendix A attached.

(b) Gas Producer Plant

The gas producer plant was to be housed in a substantial building of steel construction, to be erected adjacent to the open hearth furnace building. Exhibit No. 10 is a detailed drawing of the gas producer building prepared by the H. A. Brassert Company in accordance with the specifications. Exhibit No. 15 contains the specifications for the gas producer plant, complete with steel building, gas mains, coal and ash handling equipment.

(c) Rolling Mill

The rolling mill department was to include a blooming mill and a continuous billet and sheet bar mill. Specifications covering the rolling mill department are attached as Appendix B.

Exhibit No. 16 is a drawing of the blooming mill and continuous billet and sheet bar mill buildings as prepared by H. A. Brassert Company in accordance with specifications.

Exhibit No. 17 sets forth the specifications for the blooming mill.

Exhibit No. 18 sets forth the specifications for the 7000 HP alternating current blooming mill motor.

Exhibit No. 19 sets forth the specifications for the continuous billet and sheet bar mill.

The blooming mill was to have capacity to roll 2000 tons of steel ingots weighing 5000 kilograms each down to 180 millimeter square blooms in 20 working hours. The continuous billet and sheet bar mill was to operate in tandem with 40 inch blooming mill with the acpacity to roll billets 50 millimeters square and sheet bars 8 inches wide weighing 7-1/2 lbs. per mm. foot.

C. Employes

It is estimated that during the year 1941 Honkeiko employed approximately 7,000 people at the two plants. Of these nearly 2,000 were Japanese, the balance being Manchus and Chinese coolies. Most of the employes lived as close to the plant as possible.

All the Japanese were considered skilled laborers and only about 5 per cent of the Chinese received wages as skilled workers. The Chinese coolies in 1941 were given an average wage of approximately 2 yen per day including such items as medicine, food, and clothing.

D. Railroad Facilities

The Honkeiko Steel Works owns all of the railroads and tracks in its plant including the railroad between the new plant and the coal mine, and between the plant and its connection with the Mukden-Antung Railway. In 1941 it had about 5 locomotives and 100 freight cars, and a repair shop was kept for maintaining the railroad equipment. The railroad extending from the coal mine and serving the new plant has an estimated trackage of four miles. A railroad bridge approximately 600 feet long is erected across the Taishi River at this point. If this bridge were destroyed a serious problem of transportation would be involved because Honkeiko, at least for the new plant, would be forced to obtain its coal from other sources. For locations of the railroad tracks see Exhibit No. 1 and 8.

E. Power Supply

Both plants of the Penhsihu Steel Works obtain their power from a power plant owned and operated by the company which is built west of the Taishi River, a short distance south of the railroad bridge of the Mukden-Antung Railroad crossing the Taishi River. This power plant supplies electric current for the city of Penhsihu area, in addition to the requirements of the Steel Works.

The building is of concrete construction and surrounded by a brick wall. It has one large, concrete smokestack. Coal is used for generating electricity. Its power-generating facilities were estimated as containing either four 25,000 kva units, or two 35,000 kva units. Exhibit No. 3 shows the wall surrounding the Honkeiko power house and the road alongside the Taishi River.

F. Military Protection

As early as 1941, elaborate precautionary measures were taken for the defense of the two plants of the Honkeiko Steel Works. It is believed this entire area has been fortified for the protection of this vital section. At Penhsihu it is estimated 1,000 soldiers are constantly guarding this vicinity. Block houses and pill boxes have been built and all strategic places such as railroad stations, bridges, and power plants are protected. Great precautions were taken for blacking out the district in the event of night air-raid drills. Blackout practice and air-raid drills were held at frequent intervals and an elaborate system was worked out to enforce the blackout rules and regulations. On the mountains on both sides of the Honkeiko plant anti-aircraft guns have been installed. Another protective measure was the ban on the growing of maize within a certain distance of railroads. This rule was passed to prevent the possibilities of guerrillas hiding in the high grain in the proximity of railroads.

Early in 1941 measures were taken to camouflage the Honkeiko Steel Works including the application of camouflage paint to the smokestacks and to the tops

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of the buildings. This camouflage extended over other buildings in the vicinity. At that time no bomb shelters of any kind had been constructed.

It is believed the first effect of any sporadic bombing in this area would be for the Chinese coolies to leave with their families, if possible for them to do so, for places of safety in rural sections. The management at the Honkeiko Company in cooperation with other industrial plants in Manchuria have given serious consideration to this problem.

VI. ADJACENT INDUSTRIAL AREA - PENHSIHU CEMENT CO.

The Penhsihu Cement Co. was organized by the Okura, Asano, Shibusawa, and the Furukawa interests of Japan in 1935. The plant of the company stands on a vast site about 4 kilometers southwest of the Penhsihu station on the Antung-Mukden line of the South Manchuria Railway. It is conveniently connected to the Penhsihu Iron Works by a light oil engine motor car service. The area of the mill site is about 136,000 square meters while the floor space of the buildings aggregated 10,162 square meters. The plant includes a 300 metric ton raw material silo, a 10,000 metric ton cement silo, limestone crushers, coal crushers, dryers, mills, rotary kilns, and cement packers.

The coal used at this plant is available in the surrounding hills and the principal raw material, limestone, is found in the many quarries around the plant and is conveyed by aerial carriers direct to the mill. Iron and other slags are supplied from the Iron Works. Gypsum is shipped from Japan. Cement produced by this company has good weathering qualities and strength.

VII. SOURCES OF INFORMATION

The information upon which this report is based was obtained from Mr. Ralph Vaill and Mr. J. H. Van Campen, both of whom are engineers familiar with the Manchurian iron and steel situation.

1. Mr. Ralph Vaill. Mr. Vaill was born in Montana in 1890 and educated at the United States Naval Academy from 1906 to 1913. He studied metallurgy with Mr. Waterhouse of the Lackawanna Steel Company of Canada. Later he was associated with the Republic Iron and Steel Works, the Crucible Steel Company of America, the Freyn Engineering Company, the Open Hearth Combustion Company, and the H. A. Brassert Company.

In 1932 he was sent by the Freyn Engineering Company to Russia as metallurgical consultant for the G.U.M.P., where he remained until 1937. From 1937 to 1938, Mr. Vaill was with the Open Hearth Combustion Company, 310 South Michigan Avenue, Chicago, Illinois, a concern affiliated with H. A. Brassert & Company whose address is 60 E. 42nd Street, New York, New York.

In April of 1938, Mr. Vaill, with Mr. Van Campen and another engineer, was sent by the H. A. Brassert Company to Manchuria, to make a survey of iron and steel facilities. From April to October of 1939 Vaill again returned to Manchuria in this connection.

From March 1940 to May 1941 Mr. Vaill was employed by the Manchurian Heavy Industries Development Corporation as a technical adviser for its Iron and Steel Section. At the present time Vaill is employed as staff engineer by the Open Hearth Combustion Company of Chicago, Illinois.

2. Mr. J. H. Van Campen. Mr. Van Campen was born in 1888 and graduated as a mechanical engineer from Pratt Institute. He was employed for six years with the Bethlehem Steel Corporation at Bethlehem, Pennsylvania as a steel plant engineer and superintendent of the machine shop. For five years thereafter he was employed by the Midvale Steel Ordnance Company of Coatesville, Pennsylvania as assistant chief engineer. In 1924 he was employed by the Timken Roller Bearing Company of Canton, Ohio as special engineer on anti-friction bearings for steel plants and railroads. From there he went to E. W. Bliss Company of Salem, Ohio as chief engineer.

For seven years he was chief engineer of the Republic Steel Corporation and for three and a half years he was chief foreign engineer of the H. A. Brassert Company.

In 1938 and again in 1939 Mr. Van Campen, with Mr. Vaill and another engineer, was sent by H. A. Brassert Company to Manchuria for a survey of its iron and steel facilities. After this survey was completed, he was employed for one year as a consulting engineer for the Otani Steel Industries syndicate, with headquarters in Tokyo, Japan.

In 1941 when political conditions in Japan became strained, Mr. Van Campen terminated the contract and returned to the United States. Since that time he has been employed by the Continental Ordnance Corporation as consulting engineer.

APPENDIX A

Equipment specified for Proposed Open Hearth Plant

Ten (10) E.O.T. cranes complete, exclusive of motors, controls and wiring.

Gas producer plant, including coal handling, six (6) producers, gas mains, valves, and ash cars.

Mixer, 800 ton, including steel work, casting, tilting mechanism, and gearing. Exclusive of motors, controls, wiring, refractories, and gas piping.

Two (2) 300-ton tilting open hearth primary furnaces, including steel work, castings, watercooled door and door frames, tilting mechanism and gearing, and automatic temperature controls. Exclusive of motors, controls, and wiring, and all brick and refractories and stack.

Five (5) 120-ton tilting open hearth finishing furnaces.

Seven (7) waste heat boilers for the open hearth furnaces, including boiler fittings, superheaters, safety valves, steam connections between boiler and superheater, induced draft fans, breeching, and three (3) boiler feed pumps.

Three (3) electric storage battery type, 30" gauge locomotives with air brakes, sanders, cabs, headlights, bells and two batteries each, and battery charger.

Two (2) 4'-8 1/2" gauge, 65 M. T. roller bearing ladle transfer cars, to be handled by the electric locomotives.

Twelve (12) 30" gauge welded steel roller bearing ingot cars to carry two ingots at five M. T. each, with stools and molds, to be handled by the electric locomotives.

Ten (10) 4'-8 1/2" gauge slag cars (without pots) to carry 280 cubic ft. pots, complete with roller bearing trucks, couplers, steam operated dumping cylinders and trunnion rings. To be handled and operated with existing steam locomotives.

Ten (10) riveted steel ladles to hold 60 M. T. steel complete with trunnions, slag spouts, and stopper rigging, but exclusive of lining.

One (1) lever type scrap shear for stockyard, exclusive of motor and control.

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One (1) 150 M.T. 4'-8 1/2" gauge track scale, with deck beams, deck, rail chairs, rail blocks, and clips for live and dead rails, but exclusive of rails.

Two (2) 20 M.T. charging box scales, each to weigh three fully loaded charging boxes simultaneously, with supporting I-beams, and decking.

APPENDIX B

Proposed Rolling Mill Department Specifications

Seven (7) cranes.

Six (6) circular soaking pits, with recuperators, burners, automotive controls, lids, and two lid lifting cranes, but exclusive of brick and stacks.

One (1) 40", 2-high reversing Blooming Mill complete with ingot tilter and scale, tables, manipulator, bedplates, spindles and universal couplings, pinions, screwdown and one set of rolls and operators pulpit. Including shear, crop conveyor, bloom scales, pusher, bloom cooling bed and all tables to the continuous mill. Exclusive of all electrical equipment, and foundation bolts.

One (1) 7000 HP, 700 Volt, D.C. reversing blooming mill motor with 6000 Volt A.C. Ilgner fly wheel set, complete with all circuit breakers, regulators, switchgear, controls, switchboard panels and instruments. Exclusive of all wiring unless otherwise noted.

One (1) continuous, constant speed, sheet bar and billet mill in two sections: Section No. 1 of two (2) stands with 26" x 40" rolls, and Section No. 2 with six (6) stands of 22" x 40" rolls. Including bedplates, drives, spindles and couplings; three (3) sets of vertical edgers, and one set of rolls for each horizontal and vertical stand. Including all tables, flying shear, bar piler, skew tables; cooling beds for billets and sheet bar, and billet shear. Exclusive of all electrical equipment and foundation bolts.

One (1) 1000 HP, 6000 Volt, 500 RPM, three phase, 50 cycle, A.C. synchronous motor for stands Nos. 1 and 2.

One (1) 4500 HP, 6000 Volt, 500 RPM, three phase, 50 cycle, A.C. synchronous motor for stands Nos. 3 to 8 inclusive.

Motors to be complete with circuit breakers, switchgear, controls, switchboard panels, and instruments. Exclusive of all wiring unless otherwise noted.

June 3, 1938.

HONKEIKO STEEL WORKS

OPEN HEARTH DEPARTMENT

ONE HOT METAL MIXER

SPECIFICATION NO. N-790-D

Contractor will furnish the iron and steel work for one (1) 800-Ton mixer complete with equipment, described as follows:

One (1) Screw Drive with provisions for two (2) driving motors. Safety return mechanism on tilting drive.

One (1) Receiving Hopper on the side of the mixer, with door operating mechanism mounted on the mixer.

One (1) Combination Oil, Tar or Coke Oven Gas Burner, complete with valves and piping, and blower mounted on the top of the mixer. Platform on the mixer for access to burner and door hoist equipment.

Contractor does not include any refractory lining, motors or control, or working platform around the mixer.

The mixer will be completely fabricated and machined, and assembled in the shop, then given one coat of linseed oil paint and dismantled. It will be crated or bundled for export shipment.

Two 65 H.P. Motors, and Controls for reversing, one 10 H.P. Motor and brake and control for door hoist, and one 10 H.P. Motor with push button starter for the burner fan will be required.

About 65,000 - 9" equivalent of fire brick will be required. The bottom lining is 24" thick; the roof lining is 18" thick.

The shipping weight is 225 Metric Tons, and about one-half of this is subject to heavy lift charges.

Exhibit 11

June 3, 1938

HONKEIKO STEEL WORKS

OPEN HEARTH DEPARTMENT

TWO 300-TON TILTING OPEN HEARTH FURNACES

SPECIFICATION N-790-E

The Contractor will furnish the iron and steel work for two 300-Ton open hearth tilting furnaces. These furnaces are to be located in one end of the open hearth building near to the five 120-Ton furnaces. Provision is made for charging ladles of hot metal from the mixers into these furnaces on their casting side, and slag is to be taken off on the casting side.

These furnaces are to be fired with mixed coke oven and blast furnace gas of a constant B.T.U. value of 250 per cubic foot, and provision is made for use of producer gas from 7500 lbs. per hour of 13,500 B.T.U. coal. Waste heat boilers are to be used in conjunction with these furnaces.

The furnaces are designed to be placed between building columns spaced at 115 ft. centers. The top of charging floor is 18 ft. above the ground level, thus allowing ample room for heavy floor girders and deep regenerator chambers. The furnaces are 105 ft. long over-all by 28'-6" wide; provision is made for 25" of brick in the bottom, and 18" of roof brick; the sloping back wall is provided with one water cooled door frame and door of suitable size to receive a hot metal charging spout, with a slag hole underneath the door. Venturi ports are provided.

The regenerator chambers are 20 ft. long, the air regenerator being 16'-3" wide, and the gas regenerator 9'-3" wide; all dimensions are inside of brick walls.

The material and equipment which the Contractor will furnish for these two furnaces consists in detail as follows: Supporting beams, rollers and roller stands, bottom pan, binding, water cooled port and castings, seven water cooled tapered door frames and doors on the charging side, and one on the casting side, eight door operating mechanisms, motor driven furnace tilting mechanism with safety return device, air receiver and compressor, heavy steel bindings, and 1/4" sheathing plates for separate air and gas regenerator chambers, port uptakes, necks and slag pockets, water cooled chills with piping connections.

Each furnace will be provided with two reversing water cooled dampers and frames for the air flues, two 50" mushroom type air inlet valves with operating mechanism, two dampers complete with frames and covers and reversing mechanism for the gas flues, two reversing dampers for the gas inlets, one water cooled damper complete with frame cover and operating mechanism in the waste heat flue preceding the waste heat boiler, and one stack flue damper with draft regulating device.

For use when the furnaces are being operated with mixed gas as fuel, the Contractor will furnish the following described equipment for each furnace:

For the Combustion Air:

One motor driven fan, capable of delivering 17,000 cu.ft. of air per minute at 5" water static pressure, 30" diameter air mains of 1/8" galvanized steel, two air inlet hoods with hinged covers, and two 30" quick acting gate valves with reversing mechanism.

For the Mixed Gas Equipment:

Beginning at the junction of the coke oven gas main and the blast furnace gas main under the furnace charging platform, Contractor will furnish for each furnace: One 6" gate valve, one 20" gate valve, one gas mixing chamber, 20" diameter piping, two gas inlet hoods, and two 20" quick acting gate valves with reversing mechanism.

Contractor will furnish all the tilting mechanism except motors and controls. This tilting mechanism is located under the charging floor between the air regenerator chambers, and for each furnace consists of two 110-H.P. motors and two gear reducing sets, two screw mechanisms, and a cross shaft with gearing for synchronizing the operating of the two screws, two heavy roller stands and 16 rollers in couples. All this equipment is of rugged design, each motor and gear reducer being mounted on one base plate.

Foundations, brick work, draft stack, and electrical equipment are not included in this specification.

No gas producer mains, or mixed gas fuel mains are included in this proposal. The Purchaser will connect mixed gas fuel mains to the mixer chamber under the charging floor.

Each furnace will be provided with a combustion regulator.

MOTORS

For the tilting mechanism, two 110 H.P. motors are required for each furnace, also two magnetic and air operated shoe brakes, air release for safety return mechanism, and one complete control unit for operating and reversing the above motors. For the furnace door hoists eight 7-1/2 H.P. motors with brakes and reversing control units are required for each furnace. For the air fan, one 20 H.P. constant speed motor with push button starter is required for each furnace.

Any parts that may be damaged in handling will be securely boxed for export shipment. All work will be given one shop coat of linseed oil paint.

The total weight of two furnaces is 2066 Metric Tons, of which about one-fifth is in pieces weighing ten to fifteen tons.

June 3, 1938

HONKEIKO STEEL WORKS

OPEN HEARTH DEPARTMENT

FIVE 120-TON TILTING FURNACES

SPECIFICATION NO. N-790-F

Contractor will furnish the iron and steel work complete for five (5) open hearth tilting furnaces, each of 120-Tons capacity, each connected to a waste heat boiler.

These furnaces are to be producer gas fired, using gas from 5,000 lbs. of 13,500 B.T.U. coal per hour, per furnace. No equipment is provided for using any other fuel. Sixty five-Ton ladles of hot metal from the 300-Ton furnaces are to be charged into these furnaces through a spout entered into a door on the casting side of the furnace, and slag is to be taken off on the casting side.

Sloping back walls and venturi ports are provided in the design, also separate gas and air slag pockets, and separate gas and air regenerator chambers.

The five furnaces are designed to stand in a row, 105'-0" centers, with the charging floor 18'-0" above ground level. The over-all length of each furnace is 91'-6", the over-all width is 26'-0". The air regenerator chamber is 9'-0" wide x 20 ft. long, and the gas regenerator chamber is 6'0" wide by 20 ft. long, inside dimensions.

The material and equipment which the Contractor will furnish for these five furnaces consists in detail as follows: Supporting steel beams, roller stands and rollers, tilting mechanism, bottom pan, heavy steel binding, port and castings, tappered water cooled door frames and doors, and door operating mechanism, water cooled chills, structural steel binding and 1/4" steel sheathing plates for the separate regenerator chambers, and for the port uptakes, slag pockets and necks.

Bulkheads are provided in the ends of the regenerative chambers with angle iron frames and removable 1/4" sealing plates.

The following water cooled reversing dampers, frames and mechanisms are included for each furnace:

2 - for the air flues, which are 5'-0" x 6'-0"

2 - " " gas flues, " " 4'-0" x 5'-6"

2 - " " gas inlets, " " 3'-0" x 5'-6"

1 - " " waste heat flue to boiler

1 - " " stack flue with draft regulating mechanism

The size of these last two flues is 5'-6" x 7'-0"

In addition two 48" mushroom type air inlet valves, per furnace, will be furnished with operating mechanism.

Contractor does not include any overhead gas mains or underground flues, from the point where the gas producer collector mains stop, as shown on Contractor's Drawing L-2280-A to the points where the gas enters each furnace underground flue system.

The tilting mechanism consists of two motors 90 H.P. each, mounted on base plates with the gear reducers; gearing and shafting connect the two drives so that their operation through the two horizontal screws is synchronized. This tilting mechanism is located under the charging platform between the air regenerator chambers, center of motors being about 53 ft. from center of furnace.

The Contractor does not furnish any refractories, foundation bolts, motors or electrical equipment, or draft stack.

MOTORS & ELECTRICAL CONTROL EQUIPMENT

The motors required per furnace are:

2 - 90 H.P. Motors for tilting the furnace, with magnetic brakes and air release mechanism for safety return of ladle.

1 - Full magnetic control equipment for controling above motors.

6 - 7-1/2 H.P. Motors with brakes, and controllers for operating the door hoists, equipped with limit switches.

Each furnace will be provided with a combustion regulator.

Any parts of this equipment that might be damaged in handling will be securely boxed for export shipment.

All work will be given one shop coat of linseed oil paint.

The total shipping weight of five furnaces is 4535 Metric Tons; of this about one-fifth is in pieces weighing 10 to 15-Tons each.

June 3, 1938.

HONKEIKO STEEL WORKS

OPEN HEARTH DEPARTMENT

ONE (1) LEVER TYPE SCRAP SHEAR

SPECIFICATION NO. N-790-M

The Contractor will furnish one (1) electric driven lever type shear of the high knife type, of late design and very rigid construction, which will give maximum output at a minimum upkeep. Especial consideration has been given to strength, durability, compactness and accessibility.

The shear will have sufficient capacity to cut one (1) 2-1/4" square or one (1) 1" x 7" cold soft steel. Heavy section to be cut close up in the throat of the shear. When operated by a 15 HP, 975 RPM motor, the shear will make about 25 cuts per minute.

The main bed plate will be of heavy cast iron construction. The lever will be of heavy cast steel. Side thrust will be taken by guide post on bed plate equipped with renewable wearing plate. The fly wheel will be 60" diameter and will weigh approximately 1750 lbs.

The main gear will be cast iron with cast teeth, 56" P.D., 70 T., 2.51" C.P., 6" F., and will mesh with a cast steel pinion with cast teeth 8" P.D., 10 T., 2.51 C.P., 6-1/2 F. The motor gear will be cast steel and the pinion will be forged steel with cut teeth. The main gear, motor gears and flywheel will have structural steel covers.

The knives will be of special forged steel 4-1/2" x 1-1/4" x 16" with four cutting edges. The crank shaft will be cast steel; the pitman journal will be 5" diameter and 5" long, while the main journal will be 5" diameter and 9-3/4" long. The main bearings will be 5" diameter babbitted with loose caps. Intermediate bearings will be 3-1/4" diameter babbitted with loose caps.

The fulcrum pin will be forged steel 4-1/4" diameter equipped with bottom bearings and wedge adjustment. The pitman will be equipped with a Patented Breakable Cast Iron Pin in the tail end, and so arranged that an over-load on the shear will break the pin and do no further damage. There will be one (1) extra pin furnished with the shear.

The shear will occupy a rectangular space 5'-2-1/2" x 12'-9-1/2". The motor and all electrical equipment, foundation bolts and washers will be furnished by Purchaser.

Shipping Information

Approximate shipping measurements and weights of one (1) scrap shear.

Cubic Feet	Shipping Weight
310	20,600 lbs.
M. Tons	9.3

Exhibit 14

June 3, 1938.

HONKEIKO STEEL WORKS

OPEN HEARTH DEPARTMENT

GAS PRODUCER PLANT

SPECIFICATION NO. 790-C

For the gas producing plant, the Contractor will furnish the iron and steel work to house seven (7) Morgan Gas Producers, and provide six (6) producers 10'-6" inside diameter of brick lining. Each machine will be equipped with double levelers, automatic coal feeders and ash extractors, and noiseless steam blowers. We do not include the furnishing of any brickwork, or motors, or supply steam piping.

Each machine has the capacity to gasify 6000 lbs. of gas coal per hour continuously, when supplied with good coal, screened to not over 4 inch diameter, and with all fines under 3/4 inch removed. These machines are of the Morgan standard heavy construction for continuous service. The two (2) levelers are water cooled, and are pivoted to the top plate for easy replacement. The spiral ash plow is machined cast steel, and is built to make one complete revolution of the pan when the plow stop mechanism automatically releases it. This prevents too rapid cleaning of the pan and the destruction of the fuel bed. The ashes are discharged over the side of the pan into a narrow gauge car of 27 cu. ft. capacity, as shown on the attached Drawing L-2280-A.

The driving mechanism consists of a set of heavy cut steel gears, the speed reducing unit running in an oil tight housing. Each machine is driven through a line shaft provided with roller bearings, and the pulleys are 6-1/2" face by 14" diameter, running at 900 RPM. The machine makes one revolution in six minutes.

The blower is an improved, noiseless steam jet, a non-leakable connection being provided between the rotating ash pan and the stationary blower housing.

The feeder is of the drum type, 30" long with four (4) pockets, and is provided with an adjustment, so that the rate of feed may be changed. It is driven from the main producer drive.

Motors for driving the producers are not included, but should be not less than 5 H.P. per machine.

STEAM

Contractor does not furnish any steam or water piping, or gauges in this proposal, but about 1200 lbs. of steam per hour will

be required per producer. This should be dry steam at 125 lbs. per square inch gauge pressure.

GAS PRODUCER HOUSE

For the Gas Producer House, the Contractor will furnish a substantial building of steel construction, 30 ft. wide by 150 ft. long centers of columns, and 59 ft. to roof truss with #18 gauge galvanized corrugated steel roofing and #20 gauge galvanized corrugated steel siding. A steel floor is provided at the operating level of the producers, and a parabolic bunker, with a capacity of 700 tons total, is to be built in with gates and spouts. The building is included in Specification No. 790-A-1.

GAS MAINS AT THE PRODUCER HOUSE

Contractor will furnish a gas main, ranging in pipe diameters from 4'-6" to 8'-3" of 3/8" plate with explosion doors, mushroom and bell valves, walkways and stairs, and a burn-out stack 75 ft. high, all about as shown on Drawing L-2280. The mains are designed for 4-1/2" of fire brick and 2-1/2" of insulation, but Contractor does not include any brick or other refractories, or any valves not specified above.

COAL HANDLING EQUIPMENT

For the Coal Handling, Contractor will furnish a steel building 33 ft. wide by 60 ft. long by 33 ft. to roof truss. This building is included in Specification No. 790-A-1.

The mechanical equipment, which the Contractor will furnish, consists of the following motors furnished by Purchaser.

(1) Two (2) 17 inch wide by 89 ft. flight conveyor elevators, 15 ft. of which is in a horizontal position under the track hopper, and 74 ft. is an inclined elevator; one elevator is right-hand; one is left-hand. Each elevator is driven by a 15 H.P. motor, and geared to travel at a speed of 25 ft. per minute. With each conveyor elevator will be furnished 190 ft. of alloy steel chain with 17 inch wide flights on 10 inch centers. At the top end will be a discharge spout.

Due to the fact that the Morgan producer is designed to handle coal with lumps of 4 inch maximum size, the elevators are designed to meet this requirement, and consequently each elevator will have a capacity of approximately 40-Tons of coal per hour. It is essential that two (2) elevators be provided.

(2) One (1) shuttle belt conveyor 30 inches wide by 75 ft. center of shafts. This conveyor is driven by a 5 H.P. motor; the belt speed is 100 ft. per minute, and it will distribute the coal, as received from the elevators, over the storage bunker. The conveyor runs on a track of tee

head rails, supported from the coal bin structure. It is driven by a 3 H.P. motor, independent of the conveyor belt drive. The belt carriers are fitted with Timken roller bearings, arranged for high pressure lubrication.

There is a walkway along the belt conveyor runway. The belt is a special rubber conveyor belt 30 inches wide, five ply, 28 ounce duck, with 1/8 inch extra rubber cover on the carrying surface, and 1/32 inch extra rubber cover on the pulley side.

Contractor does not furnish any tracks, or track hoppers in coal handling building, and it is assumed that the Purchaser will provide the track hoppers, and deliver coal already crushed and screened.

ASH HANDLING

Contractor will furnish 10 dump cars of 27 cu. ft. capacity, to run on 30 inch gauge track. These cars are of the swivel dump type, made of #10 gauge steel ends and sides, with 12 inch diameter track wheels. Contractor does not provide tracks, trestle or dumping platform for the disposal of ashes.

TOTAL SHIPPING WEIGHT	METRIC TONS	CU. FT.
Coal Handling	111	8,200
6-Producers	194	13,170
Producer Piping	211	5,200

HONKEIKO STEEL WORKS June 3, 1938.

40" REVERSING BLOOMING MILL

SPECIFICATION N-790-P

General Drawing of Proposed Mills L-2298

Contractor will furnish one (1) Blooming Mill arranged to roll 2000 tons of mostly mild or soft steel ingots weighing 5000 Kg. each, down to 180 mm square blooms in 20 working hours. The smallest billet that will be rolled on the Blooming Mill is 130 mm square.

The size of ingots is approximately 630-650 mm square at bottom and 1800 to 2000 mm high weighing 5000 Kg. This mill is designed to roll steel for a continuous billet and bar mill which is described in another specification No. N790-R.

The detail description of the Blooming Mill which the Contractor will furnish is divided into the following items:

ITEM I: INGOT TILTING MECHANISM.
Consisting of a motor operated tilting pot having substantial cast steel pot designed to receive ingot of maximum size as specified above from soaking pit crane and turn ingot over onto Mill Approach Table. Pot is trunnion mounted and arranged to be tilted by cranks and connecting rods (one on each side of the pot) from an entirely enclosed motor operated double reduction drive. Flexible motor coupling and welded steel motor base are included.

ITEM II: ONE (1) MILL APPROACH TABLE with ingot weighing platform. Centerline to centerline of end rollers - 27'-0" with 13 rollers 14" dia. x 36" long spaced on 27" centers. First four rollers solid forged steel; remainder cast steel trunnion type.
Table will be of the continuous cast girder type construction with entirely enclosed bevel gear and line-shaft drive driven from integral enclosed spur gear reducer. Table will be roller bearing equipped throughout.
Drive is designed to operate table at a speed of 200 F.P.M. Ingot weighing platform having a capacity of 20,000# built under table.
Lifting device, motor operated.
Platform 8 ft. x 5 ft. with non-recording beam, and springless precision weightograph. Beam and weightograph built and marked for Kilos.

ITEM III. ONE (1) FRONT AND ONE (1) BACK MILL TABLE.
Centerline to centerline of end rollers - 45'-0" with 21 rollers 16" dia. x 84" long spaced on 27" centers. Four rollers solid forged steel; remainder cast steel trunnion type.
Table will be of the continuous cast girder type construction with entirely enclosed bevel gear and lineshaft drive driven from integral enclosed spur gear reducer.

Table will be roller bearing equipped throughout. Drive is designed to operate table at a speed of 500 F.P.M.

ITEM IV: MANIPULATORS.
There are two manipulators, one for the front mill table and one for the rear mill table. Each of the four side guards is driven by an independent motor, through an enclosed gear with rack and pinion. There are two sets of tilting fingers, one on each side of the mill, driven by independent motors. All parts are readily accessible, the driving mechanism being arranged for mounting on foundations entirely clear of the mill tables.

ITEM V. ONE (1) 40" 2-HIGH REVERSING BLOOMING MILL
Consisting of the following:
Two Rolls, forged steel, about 38" dia. x 84" long, mounted in babbitted bearings.
Screwdown, worm and spur gear type, two-motor operated, with 14" dia. screws and a speed of about 230" per min. Top roll is balanced by adjustable counterweights through levers and push rods.
Spindles, forged steel, with universal couplings on both ends and two carrier bearings for each spindle. Pinion stand with babbitted bearings and two 40" P.D., 66" face pinions which have double helical cut teeth. Universal lead spindle with carrier.
Motor operated roll changing rig.
Mill is to be driven by a 7000 HP motor at 0/50/140 RPM, which is described in Contractor's Proposal N790-Q.

ITEM VI: ONE (1) SHEAR APPROACH TABLE.
Centerline to centerline end rollers - 56'-0" with 12 rollers 12" dia. x 40" long, spaced on 4'-0" centers.
Cast steel trunnion type rollers.
Table will be of the individual mitre pot type with entirely enclosed bevel gears and lineshaft drive driven from integral enclosed spur gear reducer. Table will be roller bearing equipped throughout. Drive is designed to operate table at a speed of 388 F.P.M.

ITEM VII. ONE (1) SHEAR TABLE.
Centerline to centerline end rollers - 5'-0" with 4 rollers 12" dia. x 40" long, spaced on 20" centers. Solid forged steel rollers.
Table will be individual mitre pot type with entirely enclosed bevel gears and driven through a lineshaft from the Shear Approach Table.
Table will be roller bearing equipped throughout. Speed of table 388 F.P.M.
One set of hand adjusted side guides in front of Shear is included.

ITEM VIII: ONE (1) #125 UP AND DOWN CUT HOT BLOOM SHEAR. 36" long knives, motor driven through helical out gearing, and a motor operated throw-out clutch.
Capacity 10" x 10" hot steel blooms.
Speed about 12 strokes per minute.
Minimum length of out 72"; maximum 17'-0".

ITEM IX: ONE (1) HYDRAULIC ACCUMULATOR for Shear Knife Head Balance, of the rising plunger type, with the weight tank suspended from the top of the plunger.
Displacement about 8 gallons; working pressure 1600#.

ITEM X: ONE (1) SHEAR GAUGE.
Motor tilted and motor traversed through a single screw and provided with self-relieving device which moves gauge head away from out piece on tilting range, 72" min. length 17'-0" max. length.

ITEM XI: ONE (1) CROP HOIST AND CHUTE.
Crop chute, cast type, with hand operated gate.
Crop hoist, inclined, bucket dump type, operated by means of cable and sheave wheels through an entirely enclosed reduction unit, motor operated and arranged to deliver crop ends to car or crop bucket.

ITEM XII: ONE (1) SHEAR RUNOUT TABLE.
Centerline to centerline end rollers 51'-0" with 18 rollers 12" dia. x 40" long, spaced on 36" centers. Cast steel trunnion type rollers.
Table will be of the individual mitre pot type with entirely enclosed bevel gears and lineshaft drive driven from integral spur gear reducer.
Table will be roller bearing equipped throughout. Drive is designed to operate table at a speed of 388 F.P.M.

ITEM XIII. ONE (1) BILLET MILL APPROACH TABLE.
Centerline to centerline end rollers 42'-0" with 15 rollers 12" dia. x 40" long, spaced on 36" centers; cast steel trunnion type rollers.
Table will be of the individual mitre pot type with entirely enclosed bevel gears and lineshaft drive driven from integral spur gear reducer.
Table will be roller bearing equipped throughout. Drive is designed to operate table at a speed of 388 F.P.M.
One set of hand adjusted side guides is included at billet mill end.

ITEM XIV: ONE (1) DISAPPEARING STOP at Billet Transfer.
Motor operated. Plates are mounted in massive cast stands entirely clear of table.

ITEM XV. ONE (1) BLOOM PUSHER.
Two rams, single motor operated through an enclosed standard worm gear reduction unit, lineshaft pinions and racks.
Stroke - 8'-6".

ITEM XVI: ONE (1) BILLET TRANSFER
Reciprocating ducking dog type operated by levers through an entirely enclosed gear drive, motor operated.
Cast iron skids mounted on steel beams which are mounted on foundation.

ITEM XVII: ONE (1) SET OF CRADLES.
Eight massive cast steel stands designed to be mounted on concrete foundation.

The lubricating equipment will consist of the following:

a. One (1) centralized automatic oil system for 40" Blooming Mill screwdown, manipulators and all tables.

b. One (1) automatic oil system for Blooming Mill pinions.

c. One (1) centralized grease system for 40" Blooming Mill, manipulators, front and back mill tables and mill approach table.
Items I to V inclusive.

d. One (1) centralized grease system for shear approach table, up and down cut shear, crop hoist and chute, shear runout table and billet mill approach table.
Items VI to XVII inclusive.

The Contractor will furnish the motor and electrical equipment for driving the Blooming Mill. This is covered by proposal specification No. N790-Q.

The Contractor does not furnish any foundation bolts or washers, low pressure water system, interconnecting piping or valves or pumps, floor plates, cross-over stairways or pulpits.

Contractor does not furnish any motors, electrical control equipment, wiring or conduits, except as mentioned above.

Contractor does not include the furnishing of any spare parts or spare rolls.

The total shipping weight is 1790 metric tons.

June 3, 1938.

HONKEIKO STEEL WORKS

MILL DEPARTMENT

BLOOMING MILL MOTOR

SPECIFICATION N-790-Q

The Contractor will furnish the electrical equipment, as listed below, for the main drive of the Blooming Mill, including AC switch gear, control and ventilating equipment. The Contractor does not furnish bus and wiring between separate pieces of apparatus, (coupling included with blooming mill), foundation bolts, oil or water piping, layout drawings, or any sheet metal air duct work, partitions or dampers. The motor will be a 7,000 HP, single armature reversing mill motor, energized by a 6,000 KW flywheel induction motor-generator set, controlled by the variable voltage system through the usual master controller.

The following approximate detail data applies to the 7,000 HP motor:

Horsepower, 50° continuous	7,000 HP
Full Load Speed	50/140 RPM
Armature Voltage	700 volts DC
Full Load Armature Current	7,900 amps.

Rated Full Load Torque:

At 50 RPM (full field)	735,000 lbs. ft.
At 140 RPM (weak field)	262,000 lbs. ft.

Maximum Operating Torque:

At 50 RPM (full field)	1,650,000 lbs. ft.
At 140 RPM (weak field)	455,000 lbs. ft.

Maximum Emergency Torque:

At 50 RPM (full field)	2,020,000 lbs. ft.
At 140 RPM (weak field)	553,000 lbs. ft.
Total weight	427,000 lbs.
Heaviest part weight (arm and shaft)	148,000 lbs.

Exhibit 18

(OVER)

Approximate Time of Reversal:

Base speed to base speed	2 sec.
150% base speed to 150% base speed	3 sec.
200% base speed to 200% base speed	5 sec.
Maximum speed to maximum speed	11 sec.

The flywheel of the motor-generator set will have a stored energy of about 170,000 HP seconds when running at 600 RPM. The following approximate detail data applies to the 6,000 KW flywheel motor-generator set:

Number of generators	3
KW, 50° C. continuous	2,000 KW each
Armature voltage	700 volts
Speed	590 RPM
Full load armature current	2,860 amps.
Number of main poles	10

Induction Motor:

Horsepower	5,000 HP
Number of poles	10
Full load speed	590 RPM
Primary voltage	6,000 volts
Full load primary current	432 amps.

Flywheel:

Diameter	144 ins.
Face	18-1/2 ins.
Weight	82,500 lbs.
Material	Steel Plate

Total net weight of the motor-generator set	284,000 lbs.
Heaviest part (flywheel and shaft)	92,000 lbs.

As may be seen from the above figures on torque, the 7,000 HP motor is capable of exerting a torque 275% of full load torque in case of an emergency. This is equivalent to nearly 20,000 HP. The flywheel of the motor-generator set delivers the difference between the maximum power of the 5,000 HP induction motor and peak load of the 7,000 DC motor.

Three generators are provided rather than one, in order to provide the large commutating capacity necessary during peak loads. One 6,000 KW generator with a special commutator large enough to take the peak loads would cost more than the three 2,000 KW generators, despite the more

favorable factor of larger moment of inertia of the one large generator compared to that of the three small generators, which would reduce the size of the flywheel.

The following items of equipment are included:

1 - 7,000 HP, 50° C., rise continuous, 50/140 RPM, 700 volt, DC, reversing mill motor.

1 - 20 KW, 200 volt, single phase heater.

1 - Four-unit motor-generator set, consisting of:

a) 3 - 2,000 KW, 50° C., rise continuous, 590 RPM, 700 volt, DC generators.

b) 1 - 5,000 HP, 50° C., rise continuous, 590 RPM, 6,000 volt, 3 phase, 50 cycle, wound rotor induction motor.

c) 1 - 82,500 lb., 144 in. diameter fly wheel.

d) 2 - 5 KW, 200 volt, single phase heaters.

1 - Six-unit exciter motor-generator set, consisting of:

a) 1 - Approx. 40 KW, 50° C., continuous, 250 volt, DC, generator for the field excitation of three (3) 2,000 KW generators.

b) 1 - Approx. 75 KW, 50° C., continuous, 375 volt, DC, generator for 7,000 HP motor, shunt field excitation.

c) 1 - Approx. 10 KW, 50° C., continuous, 250 volt, DC, generator for 7,000 HP motor, indirect series, compounding excitation.

d) 1 - Approx. 10 KW, 50° C., continuous, 250 volt, DC, generator for exciter field excitation, and for control circuit supply.

e) 1 - Approx. 50 KW, 50° C., continuous, 250 volt, DC, self-excited, dynamic braking generator.

f) 1 - Approx. 225 HP, 50° C., continuous, 200 volt, 3 phase, 50 cycle, 965 RPM, squirrel cage induction motor.

1 - Set of dead front cubical switch gear, for the primary of the 5,000 HP, 6,000 volt motor.

1 - Lewis type, electrically reset, automatic slip regulator, for the secondary of the 5,000 HP motor.

1 - Set of reversing, variable voltage, magnetic control equipment, including DC meter and relay panels, generator circuit breakers, pulpit operator's panel, master switch, field resistors, etc.

A - non-recirculating system of ventilation will be furnished to supply filtered air under pressure to the basement, from which it will pass through the machines, and the heated air discharged into the motor room. The blowers will be motor-driven, non-overloadable type, and the filters of the oil film self-cleaning type. This specification gives the total capacity of the units that will be furnished. The number and size of the individual units making up the system will not be determined until final layouts are made.

The ventilating system will consist of the following:

a) 1 - Set of motor-driven blowers, totaling 130,000 CFM capacity, and including 200 volt, 3 phase, 50 cycle, squirrel cage induction motors and line starters.

b) 1 - Set of air filters, totaling 156,000 CFM capacity.

The shipping weight of the total equipment will be 16,173 cu. ft. and 392 metric tons.

June 3, 1938.

HONKEIKO STEEL WORKS

BILLET AND SHEET BAR MILL

SPECIFICATION N790-R

Contractor will furnish one (1) continuous two-high Billet and Sheet Bar Mill substantially as shown on Drawing #L-2298, arranged in two sections, one section consisting of two stands of 26" x 40" rolls driven by a 1000 HP synchronous motor, and one section consisting of six stands of 22" x 40" rolls driven by a 4500 HP synchronous motor. This arrangement permits a more flexible and cheaper operating unit than if all eight stands were driven by one motor. The finishing speed of #8 stand is 750 ft. per minute.

This mill is arranged to operate in tandem with the 40" Blooming Mill directly after the billet transfer table, and will roll billets 50 mm square to 100 mm square and sheet bar 8" wide weighing 7-1/2 lbs. per lineal foot directly from the roughed blooms rolled in the blooming mill.

The mill equipment which the Contractor will furnish is described as follows:

ITEM I: TWO (2) 26" x 40" 2-HIGH BILLET AND BAR MILL STANDS. Cast steel open top housings with ratchet type screwdown and counterweight top roll balance.
Housings are rigidly tied together at top and bottom and mounted on cast steel bedplates.
Housing windows are 28" wide x 6'-0" high.
Rolls are mounted in Ryertex bearings, 4-pod type cast steel spindles with cast steel coupling boxes. Entirely enclosed pinion stands with pinions having double helical cut teeth, mounted in babbitted bearings. One entirely enclosed spur gear drive for these two stands.
Cast steel coupling box for connecting leading spindles to pinion stands and cast steel compromise box for connecting to drive shaft coupling.
Spindle carrier with Ryertex bearings, spring cushioned two-post type mounted on extended mill bedplates.
Forged steel drive shafts with length to suit location of drive, having cast steel 4-pod type mill couplings at mill and solid cast steel couplings at drive end. Roll stands will be furnished complete with all necessary entry and delivery guides, rest bars, twist guides, etc. for one set of rolls only.
Ryertex bearings on roll stands and spindle carriers will be water lubricated from centralized system.
Housing screw boxes are fitted with connections for forced grease lubrication.
Pinions and pinion bearings will be lubricated from central system.

ITEM II: SIX (6) 22" x 40" 2-HIGH BILLET AND BAR MILL STANDS. Same as Item I except with the following exceptions: Screwdown hand-wheel operated through an entirely enclosed worm wheel reduction. Entirely enclosed bevel gear drives.

ITEM III: THREE (3) 18" VERTICAL EDGERS.
These edgers will be located on the entry side of Nos. 1, 3 and 5 mills.
Vertical roll housings are adjusted horizontally by motor driven screws, mounted in built up edging mill frame. Vertical rolls each driven by a pair of bevel and spur gears. Bevel pinion arranged to slide on a shaft driven from a spur reduction set. All gears are entirely enclosed. Edging rolls 18" dia., 6" face. The distance between the rolls can be adjusted to 40" max. opening. Edger and drive are roller bearing equipped throughout.

ITEM IV: CHUTES AND LOOPERS.
Complete entry and delivery guides for one set of rolls only will be furnished together with chutes between roll stands. Chutes will be provided with torque motor operated loopers and will be capable of handling both flats and billets.

ITEM V. FLYING SHEAR
Electrically operated flying shear having capacity to shear hot steel flats 5/8" x 8" or billets 2" to 4" square at speeds as delivered from the eight stand continuous billet mill.
Shear will be of the double crank type with eccentrically mounted cranks and with top and bottom knife-heads positioned by parallel sliding arms which insure a vertical shearing action from start to finish of cut. Shear is designed to cut lengths from 12 ft. to 36 ft. by increments of 1".
Shear is equipped with knife speed synchronizing device which synchronizes horizontal velocity of material being sheared during a cut.
The shear will be furnished complete including necessary lubrication and one set of knives for billets and one set for flats, but excluding motors, controls, magnetic clutches and all other electrical equipment, flexible couplings and foundation bolts and washers.

ITEM VI: SHEAR RUNOUT TABLE.
Lineshaft driven roller table with cast iron rollers keyed to steel shafts which are mounted in roller bearings, individual cast mitre pots, cast iron apron plates and structural steel girders.
Table is divided in two sections, each section 32'-6" centerline to centerline of end rollers.
Rollers 12" dia., 36" long spaced on 30" centers. Each section driven by an entirely enclosed drive unit. Mitre gears and drive gears are dip oil lubricated. Bearings are forced grease lubricated from a pressure grease system.

ITEM VII: PINCH ROLLS.
Motor driven pinch roll machine with nickel cast iron rolls, 12" dia. x 36" long, roller bearing mounted.
Housings, cast steel, mounted on steel base.
Top pinch roll can be pre-set to give definite opening between rolls and is adjusted by hand. Top and bottom pinch rolls are driven from an entirely enclosed pinion stand and drive. Pinion stand and motor are mounted on a separate base.

ITEM VIII: PILER.
When rolling billets, the top pinch roll mentioned in Item VII is set in the high position, and when rolling sheet bar is lowered onto the bar and adjusted by hand. The piler table is 36 ft. long, centers of end rollers. There are 19 rollers 7" dia. by 36" long, spaced 24" centers, mounted in roller bearings, individual mitre pots and mounted on structural steel girders which are tied together with cast iron separators at the piler screws. The piler screws are motor operated through an entirely enclosed spur gear drive unit and bevel gear set. As the bars come onto the piler table, the piler screws are automatically motivated, lowering the table until it has received its load of two ingots of sheet bars. There are adjustable cast steel apron plates and motor adjusted side guides. The end stop is hand adjusted. The pile of bars is removed from the piler by the special two drum, spreader beam, double hook crane, described in Specification N790-B-2, and is placed on the cooling bed (Item XI) for cooling. The cooled piles of bars are to be removed by the above described crane and stored or shipped.

ITEM IX: HOT RUN TABLE.
Lineshaft driven roller table with skewed cast iron rollers keyed to steel shafts which are mounted in roller bearings, individual cast mitre pots, cast iron apron plates, structural steel girders. Centerline to centerline end rollers 51'-0", 12" dia. x 42" long set at an angle of 80 deg. to the lineshaft and driven by an entirely enclosed spur gear drive unit.
Mitre gears and drive gears are dip oil lubricated.
Bearings are forced grease.

ITEM X: TWO (2) DISAPPEARING STOPS, motor operated. Plates are mounted in massive cast stands entirely clear of table.

ITEM XI: ONE (1) COOLING BED.
The cooling bed has been designed to carry the load of piled sheet bar for cooling only. Cooling bed is 52'-0" wide by approximately 58'-0" long with rope operated beam type sweep-off and two sets of separate rope operating ducking dog type pushovers to cradles. Grid bed, cast iron, mounted on cast iron beams which are designed to be mounted on foundation.

ITEM XI: (cont.) Rope drums are lineshaft driven from entirely enclosed gear reducers.
Tail sheaves are equipped with screw adjusted take-ups.
One set of push-overs to be for half of bed next to run-in table and one set for half of bed next to cradles.
Drive gears are dip oil lubricated, while drive bearings are flood oiled from splash gears.
Roller bearings are fitted with connections for forced grease.

ITEM XII: CRADLES.
Nineteen cast steel stands designed to be mounted on foundation.

ITEM XIII: SHEAR APPROACH TABLE.
Lineshaft driven roller table with shell type rollers which are mounted in roller bearings, individual cast mitre pots, cast iron apron plates, structural steel girders and two enclosed gear drives.
Centerline to centerline end rollers 82'-6" divided into two sections. Each section 40'-0" centerline to centerline end rollers.
Sixteen rollers 12" dia., 36" long spaced on 30" centers.
Each section is driven by an entirely enclosed drive gear unit.
Speed of table about 500 F.P.M.
Mitre gears and drive gears are dip oil lubricated.
Bearings are forced grease.

ITEM XIV: NO. 160 HOT BILLET SHEAR.
Up and down cut type shear with hydraulically balanced top and bottom knife heads.
Top and bottom knife heads are driven through an eccentric, driven from an entirely enclosed gear reduction unit through universal spindles.
Clutch is of the non-knocking type, motor operated. Drive is entirely enclosed having cut teeth gears and pinions and roller bearing mounted shafts.
Length of knives 36"
Capacity: 5 - 4" x 4" billets at a temperature of 1600 deg. Fahr.
Maximum pressure between knives 1,600,000#.
Rake of knife .15" per foot.
Shear is geared to make about 17 strokes per minute.
Moving parts of shear are fitted with connections for forced grease lubrication.
Drive gears and bearings are arranged for oil lubrication from pump.

ITEM XV: SHEAR GAUGE.
Hatchet type tilting gauge mounted on traveling gauge heads.
Gauges, motor tilted through worm reduction unit and cam.
Gauge heads, motor traversed through worm reduction units, pinions and racks. Gauge and supports are entirely clear of table.
Capacity: 6'-0" min., 30'-0" max.

ITEM XVI: SHEAR TABLE.
Lineshaft driven roller table with cast iron rollers which are mounted in roller bearings, individual mitre pots, cast iron apron plates, structural steel girders and one enclosed drive unit.
Centerline to centerline end rollers 30'-0".
Sixteen rollers 12" dia., 36" long, spaced on 24" centers.
Speed of table about 520 F.P.M.
Mitre gears and drive gears are dip oil lubricated.
Bearings are forced grease.

ITEM XVII: KICK-OFF.
Continuous chain type with two dogs per chain.
Chains, sprocket driven from entirely enclosed gear drives.
Speed of chain about 56 F.P.M.

ITEM XVIII: CRADLES.
Twelve heavy cast steel stands, designed to be mounted on foundation.

ITEM XIX: END STOP.
One heavy cast steel stand designed to be mounted on concrete foundation.

ITEM XX: ROLL CHANGING RIG for Billet and Bar Mill will not be furnished by Contractor. This can be easily built by Purchaser and drawings will be supplied by Contractor.

The lubricating equipment which the Contractor will supply will consist of the following:

a. One (1) centralized oil system for three 18" vertical edgers.

b. One (1) oiling system for billet mill pinion stands and drives.

c. One (1) oiling system for flying shear.

d. Two (2) grease systems for Items I to XIX inclusive.

Contractor will furnish the motors and electrical equipment for driving the billet and bar mill. This is covered by Proposal Specification N790-S.

The Contractor does not furnish any foundation bolts or washers.

Contractor does not furnish any motors, electrical control equipment, wiring or conduits, except as mentioned above.

Contractor does not furnish any low pressure water system, interconnecting piping, valves or pumps, floor plates, crossover stairways or pulpits, nor any spare parts.

The total shipping weight is 2337 metric tons.