PLAINTIFF'S EXHIBIT
ARO-172

ENGINEERING REPORT

PROJECT NO. 7147
SLAB MILL MODIFICATIONS

MIDDLETOWN WORKS

Volume I

March 15, 1965

KAISER ENGINEERS, INC.

Report No. 7147-1

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2.0 FACILITY DESCRIPTION

The new slab mill modifications, as shown on drawing PR-3297-963, combined with the present facilities will provide a primary mill installation employing the "cold slab practice" and consist of the following:

2.1 Soaking Pits (Existing)

The pits are located centrally in the building, forming a "T" with the slab mill roller table line. Ingots are heated in 36 pits, 20 of which are in 10 rows of two pits each, and 16 in 4 rows of four pits each. All pits are heated by coke oven gas with pressure and temperature controls and have the following dimensions:

Row	No. Pits	Type	Dimensions	Unit Hearth Area
1,2, 3,4, 5,6	2 each	Cross-Fired Regenerative	Length 13'-0" Width 14'-0" Depth 9'-2½"	182 Sq. Ft.
7	4	One-Way Recuperative	Length 18'-4" Width 6'-4" Depth 11'-5"	116 Sq. Ft.
8	4	One-Way Recuperative	Length 23'-4" Width 6'-4" Depth 12'-1"	147.7 Sq. Ft.
10	4	One-Way Recuperative	Length 18'-4" Width 6'-4" Depth 11'-8"	116 Sq. Ft.
11	4	One-Way Recuperative	Length 18'-4" Width 7'-0" Depth 12'-5"	128.3 Sq. Ft.
9,12, 13,14	2 each	Cross-Fired Regenerative	Length 15'-0" Width 14'-1½" Depth 9'-2½"	211.8 Sq. Ft.

The total hearth area of the soaking pits is 5,910 square feet which is estimated to provide a maximum peak productivity rate of 355 tons per hour based on heating 60 tons per hour per 1,000 square feet. This is equivalent to 246,000 ingot tons per month operating 20 turns per week.

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2.2 45 Inch by 120 Inch Slabbing Mill (Existing)

The existing mill equipment to be utilized for cold slab practice will comprise the following:

- Two Ingot Buggies — 600/1200 FPM
- Ingot Receiving Table 19'-5" long — 398 FPM
- Mill Approach Table 20' 9-3/4" long — 398 FPM
- Mill Entry Table 27'-9" long — 375 FPM
- Front Mill Table 13'-6" long — 375/750 FPM
- 45 Inch by 120 Inch Two-high Slabbing Mill, Rolls individually driven at a speed of 475/946 FPM by two 5000 HP, 40/80 RPM motors. Two (2) entry feed rolls, two (2) delivery feed rolls. Fifteen inch diameter screws, 2 inch pitch driven by two (2) 150 HP, 450 RPM motors.
- Mill Delivery Table 33'-0" long — 375/750 FPM (This table will receive a general overhaul as part of the scope of work)
- Vertical Edging Mill - 40 inch diameter rolls driven by a 2000 HP, 100/200 RPM motor. Maximum roll opening is 76 inches.
- Edger Delivery Table 13'-6" long — 302 FPM (This table will receive a general overhaul as part of the scope of work)
- Scarfer Approach Table 33'-0" long — 302 FPM
- Scarfer Unit is a Linde CM-43, two sided unit.
- Shear Entry Table 33'-0" long — 302 FPM
- Slab Shear driven by two (2) 250 HP motors and suitable for shearing a 76 inch wide by 5.5 inch thick maximum slab.
- Shear Pull-back Table 12'-1" long — 250 FPM
- Transfer Run-in Table 33"-1½" long — 302 FPM

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2.3 Mill Machinery (New Equipment)

All new equipment will be designed to suit the 100,000 pound continuous cast slab in the event that this equipment is relocated in the future, and be interchangeable with machinery items of the new hot strip mill to minimize spares. The new equipment will comprise the following:

- Shear Approach Tables (2)
- Shear Entry Table
- Motor Operated Adjustable Sideguards
- 900 Square Inch Downcut-Upcut Type Mechanical Shear
- Deflector Gate and Crop Chute
- Crop Car and Cable Hoist
- Shear Delivery Table
- Shear Run-out Table No. 1
- Shear Run-out Table No. 2
- Slab Scale
- Slab Stamper
- Scale Table
- Slab Transfer
- Four (4) Disappearing Stops
- Two (2) Water Wheel Type Slab Coolers and Pushers
- Water Wheel Tables
- Three (3) Slab Pilers
- Recirculating Oil Systems
- Grease Systems
- Hydraulic Systems

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- Slab Shear Operators Pulpit
- Slab Pusher Operators Pulpit
- Scale Removal System

2.4 Water Piping Modifications

2.4.1 Mill Service Pumps

The mill service pumps are presently located in the basement of the power house between column rows 19 and 20. There are four existing pumps as follows:

2 Worthington Pumps - Model 12L3 - present rating of 5000 gpm at 130 feet head - with 200 HP motor at 25 cycle.

1 Worthington Pump - Model 12LA3 - present rating of 5000 gpm at 130 feet head - with 200 HP motor at 25 cycle.

1 Worthington Pump - Model 12LA3 - present rating of 5000 gpm at 175 feet head - with 300 HP motor, 1750 RPM, 440 volt, 3 phase, 60 cycle.

The two pumps, model 12L3 are to be relocated to the new pump house and modified to provide 5000 gpm at 175 feet head with a 300 HP motor, 1750 RPM, suitable for 2300 volt, 3 phase, 60 cycle supply. The 25 cycle pump, model 12LA3 is to be removed and stored. The 60 cycle pump, model 12LA3 is to be relocated to the new pump house.

These pumps provide raw river make-up water to the existing clarified water system for the slabbing and hot strip mills.

Existing Clarified Water System

The mill service pumps supply the raw river make-up water from the hot well and cold well to the system through a 12 inch pipe, to a dirty well located at No. 1 concentrator. The system can also be supplied through the 16 inch pipe which completes a loop with the 12 inch line. The system description is as follows:

The water from the existing slab mill and part of the existing hot strip mill is drained via flume which conveys the water to No. 2 concentrator. From this concentrator the water is pumped through a 20 inch pipe to the mixing tank. It is then conveyed to the flocculation tank, then to the clarifiers.

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The remaining water drained from the hot strip mill is conveyed via flume to No. 1 concentrator. From this concentrator it is pumped through a 24 inch pipe to the mixing tank. It is then conveyed to the flocculation tank, then to the clarifiers.

From the clarifiers the water is conveyed by gravity flow to the clear well which is located at concentrator No. 1. The water is pumped from the clear well to the system through a 24 inch pipe. The 12 inch line from the mill service pumps connect to this 24 inch line at about column row 22 of the slab mill building. Beyond the takeoff to the bar mill booster pumps the line reduces to 20 inches. It is then reduced to 16 inches at the roll cooling towers and continues back to the mill service pumps, thus completing the loop system.

The existing clarified water system is shown on drawing PR-3297-851.

2.4.2 New Piping Connections

New Facilities

The new facilities requiring water are the water wheels, slab shear and crop pit. It is proposed to recirculate an additional 8000 gpm to the water wheels through the clarified water system. This will be accomplished by tapping into the existing 16 inch header at the south end of the slabbing mill and supplying water to the new cooling towers. From the cooling towers the water will be pumped to the water wheels. The water wheel will have an overflow and drain into concentrator No. 1 for recirculation in the system.

The shear will be supplied from a branch line from the main header to the water wheel. This branch line will also supply the water cooling requirements of the new slab shear crop pit. Sump pumps will maintain crop pit water level with discharge to No. 1 concentrator system.

2.4.3 Make-Up Water

The make-up water for the cooling towers will be river water from the existing line that runs west along column row B of the slabbing mill to the new cooling towers. This line is shown on drawing PR-3297-852.

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2.4.4 Supply Header from Pumps

A new 16 inch header will be installed from the mill service pumps to the existing 16 inch line as shown on drawing PR-3297-852. A 12 inch tap will also be made into the existing 12 inch pipe that is located on the south side of the cold well, which ties into the existing 12 inch line on the north side of the cold well for feeding the soaking pits, hot process treatment, the ash disposal system, the cold process treatment and the Smith Shop.

The new 16 inch line will be placed in a trench on the east side of the crop pit. It will run north to column row D, then west to column row 19 where it will be connected to the existing 12 inch line. Also from this 16 inch line, a 12 inch line will be taken off for connection to the existing 12 inch line on the north side of the cold well.

A 14 inch line will be connected to this new 16 inch line for the emergency feed to the scarfer pumps. This new header is shown on drawing PR-3297-852.

2.4.5 Water Cooling for Air Compressors

The existing pumps:

1 DeLaval Pump - Serial No. 224093 - 1200 gpm @ 162 ft. head - with 40 HP motor, 1425 RPM, 220 volts, 3 phase 25 cycle.

1 DeLaval Pump - Serial No. 85355 - 600 gpm - 3000 RPM steam driven - 115 ft. head.

will be retained and all piping rerouted to suit the new location of the air compressors.

2.4.6 Plant River Intake System

The cold well receiving the river water for general plant supply will be a twin cell installation with provision for individual operation of each cell during the annually scheduled clean-out.

2.4.7 Hydraulic Water for Slab Mill Side Guides and Roll Balance

Water is supplied by two 1000 gpm, steam turbine pumps (one operating, one standby) at 600 psi for the operation of the slab mill side guides. The pump delivery includes an

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accumulator, compressed air type, and the pump suction is connected to a surge tank which is charged continuously with water from the existing air compressor cooling system. Well water is presently used as make-up for the surge tank.

The basic equipment items of the existing system will be relocated to the new pump house.

2.5 Electrical Power Distribution

Power for the slab mill modifications will be obtained from the 6.6 KV 3 phase, 60 cycle existing bar mill auxiliary feeder at tower No. 9. The 6.6 KV feeder routing is shown on drawing PR-3297-915. The pump house control room feeder will originate at tower No. 9 where it will tap the existing bar mill auxiliary feeder and terminate at the incoming line circuit breaker which will be included on the indoor 13.8 KV, 500 MVA metal clad switchgear located in the pump house control room.

Double ended unit substations will be parallel connected in order that both ends can be fed from the same feeder. The double ended unit substations will employ a normally open tie circuit breaker operating in a momentary paralleling scheme with the two transformer main secondary circuit breakers.

Double ended unit substations will be rated 7500 KVA at 6,600x13,200-2400 volts, 3000 KVA at 6,600x13,200-480Y/277 volts and 2000 KW at 6,600x13,200-250 volts D.C. One line diagram of these distribution systems are shown on drawing PR-3297-913 and PR-3297-914.

Each 2400 volt and 480 volt transformer will be loaded to only approximately 60 percent of its rating. This practice insures that with one transformer out of service the remaining transformer of the double ended unit, operating with the normally open tie breaker closed, can carry all essential loads on both busses. Because of its overload rating, the double ended 2000 KW constant potential 250 volt D.C. rectifier substation has essentially a 100 percent standby capacity for two hours.

Loads up to and including 200 HP will generally be fed at 480 volts; loads above 200 HP up to and including 2000 HP at 2300 volts; and loads over 2000 HP at 13,800 volts.

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Motors applied at the 2300 volt level will be breaker started or employ medium voltage starters depending on motor horsepower and frequency of operation. On the 480 volt system the motor starters will be grouped into motor control centers. Each starter in a 480 volt motor control center will consist of a three pole visible contact disconnecting device, three class J current limiting fuses, a NEMA sized contactor, three overload relays and a control power transformer.

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PROJ. SECT.	CONSTR. DETAIL	
700	---	PIPING DISTRIBUTION
701	---	SERVICE WATER

Includes the purchase and installation of all piping starting with the suction line from the new cold well at the boiler house to the three (3) relocated service water pumps and extends to the existing headers in Slab Mill Area. This account includes all interconnecting lines between existing headers and from existing headers to new cooling tower. Also included are lines to and from cooling tower to water wheels, slab mill equipment and oil cellar. All as shown on Drawing 853.

This Section includes all above ground, underground, and piping in trenches complete including ditching, concrete trenches and supports.

014	Shoring
022	Removal and Chipping Existing Concrete
034	Ditching and Backfill
120	Formwork
130	Reinforcing Steel
140	Anchor Bolts and Embedded Metal
150	Concrete
220	Miscellaneous Steel
366	Painting
461	Purchase - Pipe and Fittings
462	Purchase - Valves
464	Pipe Installation
465	Pipe Insulation
466	Hangers and Supports
467	Valve Box

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PROJ. SECT.	CONSTR. DETAIL	
700	---	PIPING DISTRIBUTION (Continued)
702	---	HYDRAULIC WATER PIPING
		Includes the purchase and installation of piping from the relocated accumulator to the tie-in to existing header. Ditching for the underground portion is covered under Section 701.
	366	Painting
	461	Purchase - Pipe and Fittings
	462	Purchase - Valves
	464	Pipe Installation
703	---	AIR PIPING
		Includes the purchase and installation of piping starting with the prefilters, to dryers and then to tie-in to existing header in Slab Mill Area. Also included is a line to the oil cellar.
	366	Painting
	461	Purchase - Pipe and Fittings
	462	Purchase - Valves
	464	Pipe Installation
	466	Hangers and Supports
708	---	STEAM PIPE
		Includes the relocation of existing steam and feedwater lines in boiler house, tie-in of existing lines along Column Row "C" of Slab Mill and new header from existing 20 inch steam line in boiler house for turbines on relocated hydraulic water pumps. Also included is a line to the oil cellar.
	461	Purchase - Pipe and Fittings
	462	Purchase - Valves
	464	Pipe Installation
	465	Pipe Insulation
	466	Hangers and Supports

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ARMCO STEEL CORPORATION
Steel Division Engineering
Middletown

LOCATION MIDDLETOWN WORKS DATE MARCH 15, 1965 DETAIL SHEET 28 OF 32
PROJECT SLAB MILL MODIFICATION PROJECT NO. 7147 BY DMB
CONTRACTOR KAISER ENGINEERS, INC. ESTIMATE NO. 47-1 NOTED

COST ACCOUNT sect.	COST ACCOUNT dept.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE L	UNIT PRICE EU	UNIT PRICE M	UNIT PRICE SC	LABOR MAN-HOURS	LABOR 00	BURDEN 10	EQUIPT. USAGE 20	MATERIAL 30	SUB-CONTRACT 50	ENGINEERED EQUIPMENT 60	TOTAL
		700 DISTRIBUTION PIPING														
701		SERVICE WATER														
	014	SHORING	900	SF	0.22	0.11	0.16		55	200	40	100	150			490
	022	REMOVAL & CHIPPING EXIST. CONCRETE		SF					30	100	20	150	50			320
	034	DITCHING & BACKFILLING	400	CY	1.75	1.00	0.75		195	700	130	400	100			1330
	120	FORMWORK	3000	SF	0.88	0.10	0.42		650	2640	400	300	1260			4600
	130	REINFORCING STEEL	8400	#	0.05		0.07		125	500	80		590			1170
	140	ANCHOR BOLTS & EMBEDDED METAL	5600	#	0.45		0.31		620	2520	380		1680			4580
	150	CONCRETE	70	CY	8.00	4.00	6.00		140	560	80	70	1120			1830
	220	MISC. STEEL & IRON	6000	#	0.10		0.30		130	600	140		1800			2540
	366	PAINTING		LS					—					1500		1500
	461	PIPE & PIPE FITTINGS		LS					—				19000			19000
	462	VALVES		LS					—				32000			32000
	464	PIPE INSTALLATION		LS					14550	71000	10000	4000	2000			87000
	465	PIPE INSULATION		LS					—					5000		5000
	466	HANGERS & SUPPORTS		LS					185	800	100		700			1600
	467	MANHOLES	1	EA					205	900	100	100	500			1600
		TOTAL: SERVICE WATER							18885	80520	11470	5120	60950	6500		169560
702		HYDRAULIC WATER														
	366	PAINTING		LS					—					100		100
	461	PIPE & PIPE FITTINGS		LS					—				1200			1200
	462	VALVES		LS					—				1800			1800
	464	PIPE INSTALLATION		LS					675	2900	400	180	220			3700
		TOTAL: HYDRAULIC WATER							675	2900	400	180	3220	100		6800
703		COMPRESSED AIR														
	366	PAINTING		LS					—					500		500
	461	PIPE & PIPE FITTINGS		LS					—				5000			5000
	462	VALVES		LS					—				2500			2500
	464	PIPE INSTALLATION		LS					3035	13200	1200	700	300			16000
	466	HANGERS & SUPPORTS		LS					345	1500	200	100	1200			3000
		TOTAL: COMPRESSED AIR							3380	14700	2000	800	9000	600		27000
		TOTAL														

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ENGINEERING REPORT

PROJECT NO. 7146

UNIVERSAL SLABBING MILL

"CHART OF ACCOUNTS"

MIDDLETOWN WORKS

VOLUME II

APRIL 15, 1966

KAISER ENGINEERS, INC.

REPORT NO. 7146-2

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PROJ. SECT.	CONSTR. DETAIL	
704	---	STEAM

This project section shall include all the costs for the steam piping within the Slab Mill Facilities. This system will start at a valved connection near the Hot Strip Mill Slab Reheat Furnaces and end with a valve at the Soaking Pit Structure.

461	Purchase - Pipe and Fittings
462	Purchase - Valves, Strainers and Traps
464	Pipe Installation
465	Pipe Insulation
466	Hangers and Supports

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PROJ. SECT.	CONSTR. DETAIL	
705	---	WELL WATER

This project section shall include all the costs for the well water piping within the Slab Mill Facilities. This system will start at a valved connection at the Soaking Pit structure and continue throughout the Slab Mill Facilities.

Also included here are the branches to the drinking fountains and valved connections at the header for branches to the Rest Rooms.

414	Drinking Fountains
461	Purchase - Pipe and Fittings
462	Purchase - Valves
464	Pipe Installation
465	Pipe Insulation
466	Hangers and Supports

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Armco Steel Corporation

LOCATION Middletown Works DATE April 15, 1966 SHEET 55 OF 63
PROJECT Universal Slabbing Mill PROJECT NO. 7146 BY
CONTRACTOR Kaiser Engineers, Inc. ESTIMATE NO. 46-2 NOTED ARL - BAS

COST ACCOUNT SECT.	COST ACCOUNT DET.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE L	UNIT PRICE EU	UNIT PRICE M	UNIT PRICE SC	LABOR MAN-HOURS	LABOR 00	BURDEN 10	EQUIPT. USAGE 20	MATERIAL 30	SUB-CONTRACT 50	ENGINEERED EQUIPMENT 50	TOTAL
700	—	PIPING (Continued)														
704	—	STEAM														
	461	Purchase - Pipe and Fittings	4560	LF	—	—	—	—	—	—	—	—	6500	—	—	6500
	462	Purchase - Valves, Strainers and Traps	257	EA	—	—	—	—	—	—	—	—	20500	—	—	20500
	464	Pipe Installation	—	—	—	—	—	—	3360	17700	2500	2100	500	—	—	22800
	465	Pipe Insulation	4560	LF	—	—	—	—	—	—	—	—	—	12500	—	12500
	466	Hangers and Supports	371	EA	—	—	—	—	100	500	100	100	1600	—	—	2300
		TOTAL - STEAM							3460	18200	2600	2200	29100	12500	—	64600
705	—	WELL WATER														
	414	Drinking Fountains	2	EA	—	—	—	—	10	100	—	—	300	—	—	400
	461	Purchase - Pipe and Fittings	2110	LF	—	—	—	—	—	—	—	—	1300	—	—	1300
	462	Purchase - Valves	43	EA	—	—	—	—	—	—	—	—	500	—	—	500
	464	Pipe Installation	—	—	—	—	—	—	740	3900	600	500	100	—	—	5100
	465	Pipe Insulation	1970	LF	—	—	—	—	—	—	—	—	—	2600	—	2600
	466	Hangers and Supports	230	EA	—	—	—	—	90	500	100	100	600	—	—	1300
		TOTAL - WELL WATER							840	4500	700	600	2800	2600	—	11200
706	—	CLARIFIED WATER														
	034	Ditching and Backfilling	2900	CY	0.75	1.20	—	—	630	2200	300	3500	—	—	—	6000
	451	Underground - Purchase - Pipe and Fittings	1460	LF	—	—	—	—	—	—	—	—	8900	—	—	8900
	452	Underground - Purchase - Valves	1	EA	—	—	—	—	—	—	—	—	700	—	—	700
	454	Underground - Pipe Installation	—	—	—	—	—	—	2280	12000	1700	1500	400	—	—	15600
	458	Underground - Coat and Wrap (Welds and Fittings)	108	EA	—	—	—	—	320	1700	200	200	500	—	—	2600
	461	Aboveground - Purchase - Pipe and Fittings	3370	LF	—	—	—	—	—	—	—	—	28900	—	—	28900
	462	Aboveground - Purchase - Valves	93	EA	—	—	—	—	—	—	—	—	31500	—	—	31500
	464	Aboveground - Pipe Installation	—	—	—	—	—	—	9780	51700	7300	6200	3000	—	—	68200
	466	Hangers and Supports	89	EA	—	—	—	—	620	3300	500	400	1700	—	—	5900
	519	Cathodic Protection	1750	LF	—	—	—	—	—	—	—	100	—	3000	—	3100
		TOTAL - CLARIFIED WATER							13630	70900	10000	11900	75600	3000	—	171400
		TOTAL														

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