EXHIBIT FILE 1 OF 2
(EXHIBITS 1-17)

EXHIBIT 1

Entergy Louisiana, LLC, Large Load, High Load Factor Power Service Rate Schedule

LARGE LOAD, HIGH LOAD FACTOR POWER SERVICE RATE SCHEDULE

I. AVAILABILITY

This Rate is available to Customers of Entergy Louisiana, LLC ("ELL" or the "Company"), for which the point of interconnection with ELL is located within the Legacy ELL Service Area, or any qualifying Customers of ELL for which the point of interconnection is located outside of the Legacy ELL Service Area.

This Rate is available where facilities of adequate capacity and suitable phase and voltage are adjacent to the premises to be served, and Service is taken according to the Legacy ELL Service Regulations (or, if otherwise agreed, the ELL Terms and Conditions) and Service Standards of the Company. Where facilities of adequate capacity and suitable phase and voltage are not adjacent to the premises to be served, Company may, at its option, require a contribution, higher minimum bill, facilities charge, or other compensation to make Service available.

Note: Generally, unless otherwise specified herein, capitalized terms used throughout this document are as defined in the Company's Terms and Conditions and Legacy ELL Service Regulations, as applicable.

II. APPLICATION

To Electric Service for Customers who contract for not less than 70 MW of firm load with facilities operating with at least an 80% average monthly electric load factor. All Service is supplied through one metering installation at one Point of Delivery. Lighting and incidental Service supplied through other Meters will be billed at the schedule applicable to such Service. Service under this schedule shall not be resold, sub-metered, used for standby, or shared with others.

III. TYPE OF SERVICE

Three phase, 60 cycle, alternating current at a transmission line nominal voltage of 69,000 volts or higher as may be available.

IV. NET MONTHLY BILL

A. Charges

Demand Charge

Firm

$10.55	per kW for the First Demand Block
$ 7.32	per kW for the Second Demand Block
$ 4.36	per kW for the Third Demand Block
$ 3.37	per kW for the Fourth Demand Block

Reactive

$0.41	per rkVA of Reactive Demand in excess of 25% of the Maximum Demand

Energy Charge

$0.00318	per kWh for all kWh

LARGE LOAD, HIGH LOAD FACTOR POWER SERVICE RATE SCHEDULE

B. Minimum Bill

The Demand Charge as applied to the Demand Billing Determinants for the current Month, plus any applicable adjustments, but not less than the sum of the First Demand Block and the Second Demand Block as defined in the Billing Determinants section of this Rate Schedule. In addition, if the average of the Maximum Demands during the preceding twelve Months falls below 70 MW, the Maximum Demand for the current Month shall be adjusted by the amount required to raise that average to 70 MW.

C. Adjustment to Charges

First - Plus or minus the applicable proportionate part of any directly allocable tax, impost or assessment imposed or reduced by any governmental authority after the effective date of this schedule, which is assessed or levied against the Company or directly affects the Company's Cost of operation and which the Company is legally obligated to pay on the basis of Meters, Customers, or rates of, or revenue from electric power and energy or Service sold, or on the volume of energy generated, transmitted, purchased for sale, or sold, or on any other basis where direct allocation is possible.

Second - The fuel adjustment will be calculated based upon the total kWh included in the monthly bill times the adjustment per kWh for the current Month calculated in accordance with Rate Schedule FA.

Third - When Company owns and maintains the substation, 1.40% per Month on the allocable investment in substation and other local facilities (excluding transmission lines and metering equipment) provided to serve Customer shall be added to the monthly bill. This provision is closed to all new applications as of May 31, 2005. On and after June 1, 2005, Customers requiring the installation of facilities other than those normally furnished for like levels of Service to similar Customers may apply for facilities Service under the terms of either Option A or B of the Additional Facilities Charge Schedule AFC.

D. Billing Determinants

The Maximum Demand for a billing Month shall be the average kW supplied during the three fifteen (15) minute periods of maximum metered use (each determined on a separate day) established during the billing Month. The Average Demand shall be the greater of a) seventy (70) MW or b) the average Maximum Demand during the 12 billing Months preceding application of this schedule or, for Customers who have not yet established a billing history, the amount established per Contract. The Demand Billing Determinants to which the Demand Charges, as adjusted, shall be applied each Month shall be as follows:

First Demand Block shall be the greater of 41,000 kW or fifty percent (50%) of the Average Demand, but not less than twenty five percent (25%) of the lesser of 400,000 kW or the Maximum Demand.

Second Demand Block shall be 15,000 kW.

LARGE LOAD, HIGH LOAD FACTOR POWER SERVICE RATE SCHEDULE

Third Demand Block shall be the difference between (a) the lesser of the current monthly Maximum Demand or the Average Demand and (b) the First Demand Block plus the Second Demand Block, but not less than zero.

Fourth Demand Block shall be the difference between the Maximum Demand and the sum of the First Demand Block plus the Second Demand Block plus the Third Demand Block, but not less than zero.

Reactive Demand shall be the average rkVA supplied during the time of the maximum kW Demands in the current billing Month.

The Energy Billing Determinants for a billing Month to which the Energy Charge, as adjusted, shall be applied each Month shall consist of the total energy measured by the Company's Meter during the Month.

When Service is metered at a voltage lower than transmission voltage of 69,000 volts, all Meter readings shall be adjusted for losses between the transmission voltage level and the point where Service is metered.

V. POWER FACTOR

Power factor shall be maintained as near 100% as practicable but shall not be leading unless agreed upon by the Company.

VI. PAYMENT

The Net Monthly Bill is due and payable each Month. If not paid within twenty (20) days from the date of billing, the Gross Monthly Bill, which is the Net Monthly Bill plus 1.5%, becomes due after the gross due date shown on the bill.

VII. CONTRACT PERIOD

The Contract shall be for a minimum of five (5) Years and, at Company's option, may be longer to justify the investment in generation and transmission facilities. Service hereunder is subject to the orders of regulatory bodies having jurisdiction and either the Company or the Customer may request lawful change in Rate Schedule in accordance with such jurisdiction.

EXHIBIT 2

CleaverBrooks, Model HSB Electric Boiler

Model HSB Electric Boiler



Model HSB Electric Boiler

- Electric horizontal steam boiler
- 1560 to 3375 kW, up to 11,813 lb/hr
- Electrical power
- 15, 150, 200 & 250 psig
- No site emissions

Cleaver-Brooks electric boilers use electricity as an energy source for zero carbon footprint and zero site emissions, ideal for meeting emissions reduction or decarbonization goals. Electric boilers are also nearly 100% efficient, meaning all energy delivered to them is converted to steam or hot water.

NEW TIP SHEET: AVAILABLE NOW! →

TIP SHEET

Electric Project Sizing

Reference Projects

Step 1: Define the heating or process steam load. Below are a few conversions to assist you.

- **1 BTU = 0.000293 KW**
- **1 KW = 3412.14 BTU**
- **1 BHP = 9.8095 KW**

Step 2: Determine the Full Load Amps (FLA) of the boiler. This will help with sizing the required wiring and an appropriate breaker.

For this exercise, let's assume we have a heating load of 800 KW, and the available commercial voltage in the building is 480 V 3 phase at 60 Hz, a very common voltage found in most facilities in the United States.

FLA is calculated by dividing the total watts of the boiler by the voltage it will use:

- 800 KW is 800,000 Watts
- 800,000 Watts ÷ 1,667 Amps
  This result is the full amperage the boiler would draw if connected to a single-phase circuit.
  Since we are using a 3-phase circuit, we need to divide this value by the square root of 3.
- 1,667/1.73 = 964 Amps

NEC Code requires that the wiring feeding the boiler be capable of handling 125% of the total load. By multiplying our FLA value of 964 x 1.25, we need to design a circuit rated for a total of 1,205 Amps.

- We can now choose the appropriate wire size for the installation using this simple calculator:
  http://wiresizecalculator.net/calculators/wiresize.htm
- For the breaker, we need to choose the closest available size from the list below:
  - 15 - 50 (in increments of 5)
  - 60 - 110 (in increments of 10)
  - 125 - 250 (in increments of 25)
  - 300 - 500 (in increments of 50)
  - 600 - 1200 (in increments of 100)
  - 1600, 2000, 2500, 3000, 4000, 5000, and 6000 Amps
- This installation would require a 1600 Amp breaker to satisfy NEC Code.
  We are ready to start purchasing equipment for this project.
  However, we are missing one last piece of the puzzle...Step 3!

Electric and Electrode boilers are effective at providing space and process heating while being 100% emissions free and highly efficient at all operating points.

Product Overview

- Compact design and smaller footprint
- No site emissions
- Quiet operation with virtually no noise emissions
- Nearly 100% efficiency at all operating points
- Ease of maintenace with reduced complexity/number of moving parts
- All units are fully packaged and ready for installation

The Cleaver-Brooks Model HSB is an immersion-element steam boiler with a horizontal, insulated vessel. This boiler is designed for the heavy-duty, continuous demand of commercial and industrial applications. Available in a vessel size of 42" diameter with an output spanning 1,560 kW to 3,375 kW. A typical Model HSB boiler system includes operating controls, elements, fuses, contactors, safety valve, and instrumentation.

Discover More

Education & Training

Cleaver-Brooks has a dedicated Training Department offering web-based programs, co-sponsored authorized representative regional programs, custom on-site programs at the customer’s facility, and programs held at Cleaver-Brooks facilities.

Learn More →

Genuine Parts

Purchasing Cleaver-Brooks Genuine Parts is the best way to keep your boiler system operating at peak performance. Our parts are precision-engineered to fit your boiler, and they are rigorously tested for quality to ensure your boiler runs safely and reliably.

Shop Now →

Rental Solutions & Services

Our rental solutions provide for: capacity increases, peak demand, plant or steam outages, equipment shutdown due to inspection, retrofit or repair, and redundancy or disaster response contingency plans.

Learn More →

221 Law St
Thomasville, GA 31792

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EXHIBIT 3

Thermon, HVJ Jet Type Electrode Boiler

HVJ Jet Type Electrode Boiler

REQUEST A QUOTE

Electrode Boilers

The Electrode boiler delivers high-efficiency, high-quality steam through its unique design, using electricity as a clean, efficient, and controllable fuel source. It converts nearly all energy input into steam with 99% efficiency, offering output control from 0-100% without the turndown limitations or inefficiencies found in fossil-fired boilers. The boiler produces zero emissions and requires no stacks. Its Jet-Flo® technology eliminates tube failures by transferring heat directly in the water within the insulated pressure vessel, ensuring 99.95% steam purity.

- Steam from: 800KW – 50,000KW
- Capacities: (2,700 pph – 167,000 pph)
- Operating pressure from 100 – 405 psi
- Voltages from: 4.16kV – 15kV

For install information, specifications and detailed information, download the PDFs below or **Find a Rep**. If you are ready to purchase this product for your organization, request a quote by filling out the form below.

PRODUCT INFO | INSTALL INSTRUCTIONS | SPECIFICATIONS | APPLICATIONS | SUPPORT

- HVJ Model Features
- HVJ Model Options

Follow Us

EXHIBIT 4

AEP Thermal Inc., Immersed Electrode High Voltage Steam Boiler 4.16 KV to 25 KV

A.E.P. - THERMAL INC.

acmetherm®

IMMERSED ELECTRODE BOILER CEJWS SERIES

REV. 2023-01

Immersed Electrode High Voltage Steam Boiler 4.16 KV to 25 KV

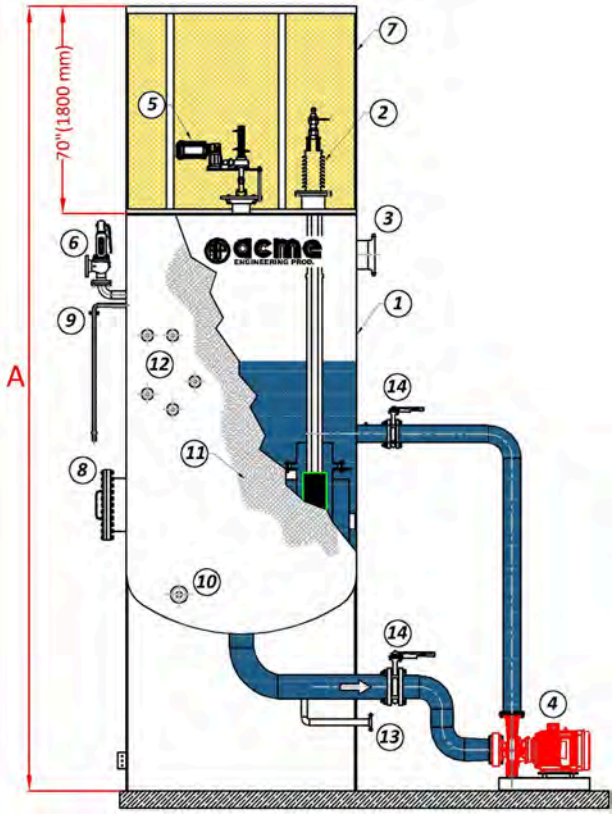
CEJWS Immersed Electrode Steam Boilers for Every Application

These Electrode Boilers have unlimited application possibilities wherever a need for process or space heating exists. A partial list of possible uses includes:

- **Hospitals, schools, hotels**
- **Catering and Food processing**
- **Clothing and textile plants**
- **Industrial plants**
- **Plastic and Chemical Plants**
- **Washing Utilities**
- **Power plants**

Electrical Requirements

CEJWS boilers are designed for use on 3-phase, 4-wire distribution (or 3-phase, 3-wire with a special grounding connection) to the circuit breaker. The boiler shell and cage must be grounded to the building steel and ground mat.



1	Pressure Vessel
2	Power Feeds (Electrodes)
3	Steam Outlet
4	Recirculation Pump
5	Motorized Drive System
6	Pressure Safety Valves
7	Safety Cage
8	Manhole
9	Instrument Manifold
10	Feed Water Connection
11	Insulation
12	Water Column Connection + Gauge
13	Bottom Blowdown + Drain
14	Isolating Valves

Operation Principles for Electrode Boilers

Electrode boilers utilize the conductive and resistive properties of water to carry electric current and generate steam. An A.C. current flows from an electrode to one phase to the grounded counter electrode using the water as the conductor.

In the section view of the boiler, water cooling flow is provided by the recirculation pump and is forced up through three jet guide pipes around the electrodes.

Since the water is the electrical resistance, this current flow generates heat directly in the water itself. The more current (amps) that flows, the more heat (BTU) is generated and more steam produced. Almost 100% of the electrical energy is converted into heat.

The amount of the steam generated is compensated by the feedwater system which is added to the recirculation water flow to have more cooling effects on the electrodes. An electronic driving system is used to interpose a concentric insulating shield between the electrode and the neutral counter electrode.

The movement of the shield increases the exposure between the electrode and counter electrode resulting in an increase of current between the two.

The barrier shield can be used to turn the boiler output down to about 10% or a 10:1 turn-down ratio. To turn the boiler down below 10%, the supply power must be interrupted.

Equipment for Model CEJWS

CONTROL

- Freestanding control panel NEMA 12 (IP54) from a separate lower source
- Pre-programmed PLC processor with HMI display
- Operating capacity control tracking MW demand
- Pressure limits
- High and low water cut-offs
- Feed Water Pump Control from water level
- Remote monitoring and reporting available

OPTIONAL ITEMS

- Duplex sets of circulation pumps if requested
- Special valves and Instrumentation
- Chemical dosing systems
- Steam separators and deaerators
- Superheaters
- Feed water system; Blowdown tank

SELECTION TABLE FOR IMMERSED ELECTRODE STEAM BOILERS

Model #	Voltage	Maximum Power Capacity	Steam Generation (212°F)Feed Water at 175 PSI (12 BAR)	Pressure Available	Boiler Dia. (B)	Boiler Height (A)	Initial Clearance Height for Power Feeds Insertion
	(KV)	(KW)	Lbs/hr. (T/hr.)	PSI (BAR)	Inch (mm)	Inch (mm)	Inch (mm)
CEJWS-6	4.16 - 6.9	2,500 - 4,200	8,300 (3.8) - 14,000 (6.4)	100 (6.9) to 300 (21)	83 (2,100)	205 (5,200)	250 (6,400)
	10 - 13.8	6,000 - 10,000	20,100(9.1) - 33,500(15.2)				
CEJWS-10	4.16 - 6.9	4,200 - 7,000	14,000(6.4) - 23,400(10.6)		100 (2,550)	225 (5,700)	270 (6,900)
	10 - 13.8	10,000 - 15,000	33,500(15.2) - 50,200(22.8)				
	20 - 25	18,000	60,300(27.4)				
CEJWS-15	4.16 - 6.9	6,500 - 10,000	21,700(9.9) - 33,500(15.2)		100 (2,550)	248 (6,300)	310 (7,800)
	10 - 13.8	15,000 - 20,000	50,200(22.8) - 67,000(30.4)				
	20 - 25	27,000	90,400(41.1)				
CEJWS-20	4.16 - 6.9	7,500 - 12,000	25,100(11.4) - 40,200(18.2)		115 (2,900)	270 (6,900)	355 (9,000)
	10 - 13.8	20,000 - 25,000	67,000(30.4) - 83,700(38)				
	20 - 25	32,000	107,000(48.7)				

Besides the standard models, CEJWS immersed electrode steam boilers are available to meet specific capacity and operating conditions by doubling the number of electrodes.

Special Design, Advantages and Features

- For direct network connection at up to 25KV/3PH/4 Wires
- Special shape design for electrodes to have the best performance in current density as well as a cooling effect
- Economical even for capacities between 2 & 20 MW
- Simple controls
- Working in low conductivity makes it suitable for pure steam demand
- Factory assembled key component POWER FEED, tested and certified for 3 times of applying volt-age and 1.5 times of working pressure.
- Can be added to an existing steam distribution system.
- Taking advantage of low off-peak electricity rates and demand charges
- Proximity sensors to control and monitor the movement and position of the shield and adjust the desired power.
- To prevent having a local high temperature around the electrodes, a high flow rate recirculation pump produces a water-cooling effect around the electrodes all the time.

Performance

High performance: convert almost 100% of the electrical energy into heat. Rapid response (full load within 30-40 minutes from cold start or within one minute from hot start).

Economical Installation: Operating at distribution voltages, eliminates the need for fuel lines, storage and handling equipment, economizers, and emission control equipment, saving on capital expenditures.

Lower operating costs: easy to operate and simple to maintain. Automatic controls reduce the operating personnel requirements.

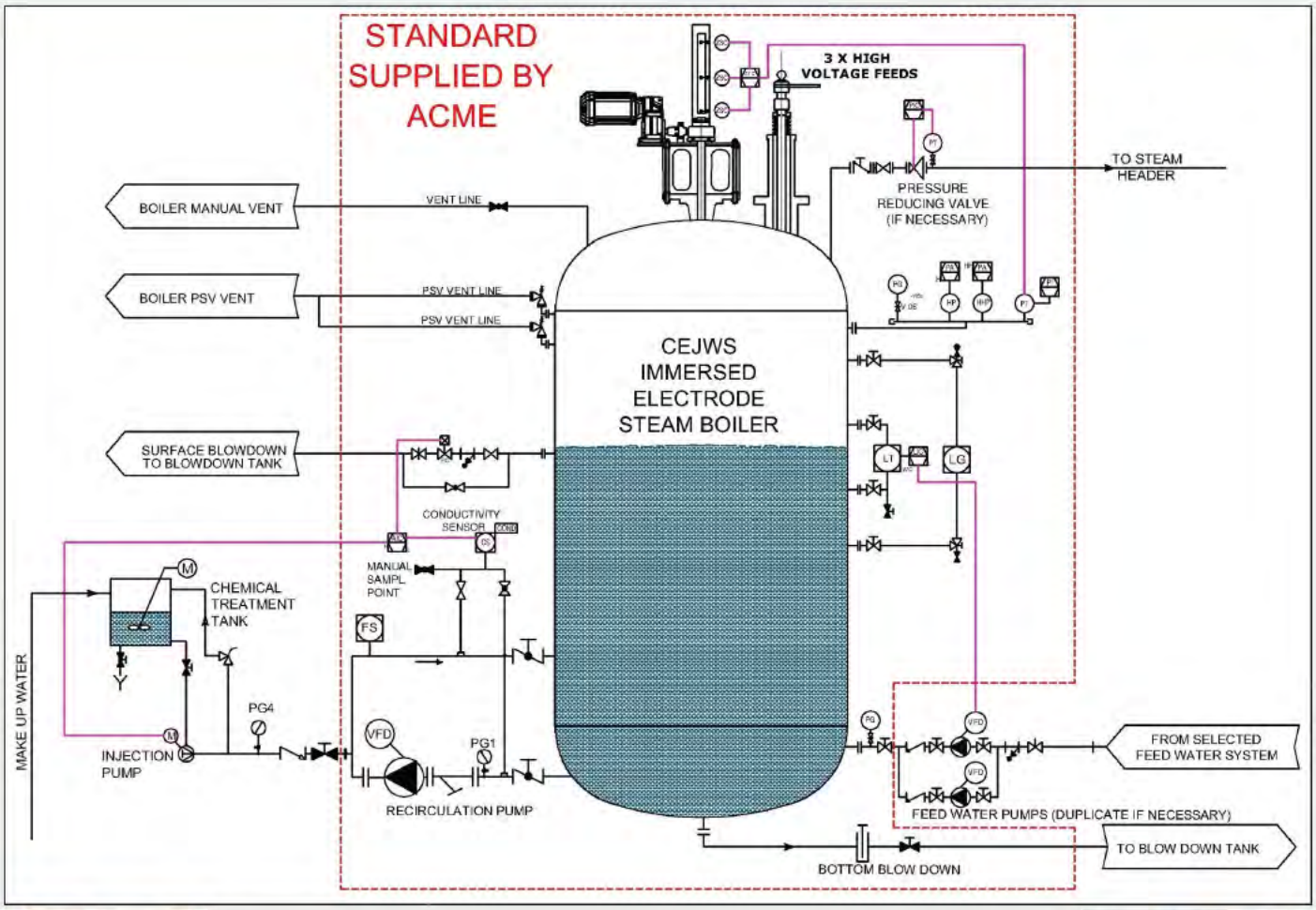
Solves energy problems: for areas affected by allocations or interruption of natural gas and costly oil supply, electrode boilers provide a dependable source of steam. Offers a clean, easier-to-use alternative to fossil fuels.

Safer operations: there are no flames, fumes, fuel lines or storage tanks. No low water danger since the current cannot flow without water. Thermal shock is eliminated. Electrically safe due to grounded pressure vessel.

Minimal maintenance: long-life electrodes are cooled by water jets produced by an integrated loop pump. Having a minimum number of components and electrical controls, provide maximum reliability. Without fuels, cleaning and maintenance are reduced.

Pollution-free: without combustion, the operation of CEJWS boilers is quiet, clean, and emissions-free. Problems associated with other energy sources such as noise, fuel fumes, fly ash, large stacks, do not exist for electrode boilers.

GENERAL P & I DIAGRAM



Water Treatment and Conductivity

The simplest way is to fill the boiler with demineralized water and add caustic soda solution (NaOH) or phosphate solution (Na_3PO_4) to achieve the conductivity required at the operating temperature.

The conductivity has to be supervised on a constant basis in order to maintain or avoid exceeding the MW capacity.

In Canada
5540 Pare St.
Mount-Royal (Montreal)
Quebec H4P 2M1
Ph.: (514) 405-1478

In U.S.A
2330 State Route 11
PO Box 460, PMB #10
Mooers, NY 12958
Ph.: (518) 236-5659

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EXHIBIT 5

AEP Thermal, Inc., High Voltage Jet Type Electrode Steam Boilers 4.16 KV to 25 KV

A.E.P. - THERMAL INC.

acmetherm®

JET TYPE ELECTRODE STEAM BOILER

CEJS SERIES

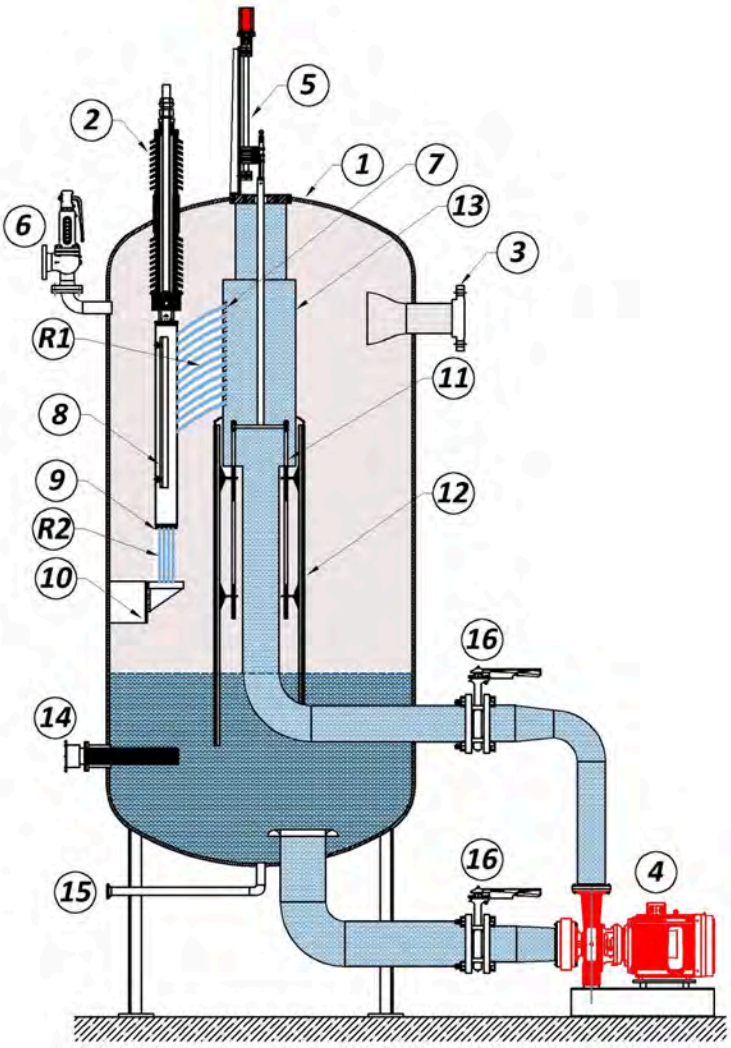
REV. 2022-11

High Voltage Jet Type Electrode Steam Boilers 4.16 KV to 25 KV

EXCLUSIVE FEATURES

- ACME has been manufacturing the CEJS high voltage jet boilers since 1980.
- These custom built, high quality boilers incorporate many unique design features.
- The CEJS range is from 6MW to 53MW, at voltages up to 25 kV, 3 phase, 4-wire,
- The standard power feed includes both inside and outside insulators and quartz tubing, all rated for 25KV and used no matter the voltage of the boiler.
- The jet nozzles include guiding vanes for the definition of the jets, both at upper and lower levels.
- The reversible target plates are enclosed in a box in order to avoid splashing which could lead to a short circuit.
- The CEJS requires only 4 loops of control, three of which could be preset.
- Capacity control is 0-100% and full power can be reached from hot standby in approximately 1 minute.
- The CEJS operates at high conductivity leading to reduced blowdown percentages.

Model CEJS cross sectional diagram



1	Pressure Vessel
2	Power Passages
3	Steam Outlet
4	Recirculation Pump
5	Motorized Drive System
6	Pressure Safety Valves
7	Nozzle Stock
8	Electrode Target Plate
9	Nozzle Plate
10	Counter Electrode
11	Control Sleeve
12	Control Linkage
13	Collection Pipe
14	Stand-by Heater
15	Bottom Blowdown/Drain
16	Isolating Valves
R1	Current Path
R2	Current Path

Operation Principles for Electrode Boilers

Electrode boilers utilize the conductive and resistive properties of water to carry electric current and generate steam. An A.C. current flows from an electrode of one phase to the neutral. The second jet flows from the electrode to the counter electrode.

Since the water has electrical resistance, the current flows generate heat directly in the water itself. The more current (amps) that flows, the more heat (BTU) is generated, and more steam is produced. Almost 100% of the electrical energy is converted into heat with no stack or heat transfer losses.

Low water protection is absolute since the absence of water prevents current from flowing and the electrode boiler from producing steam.

Unlike conventional electric boilers or fossil fuel boilers, nothing in the electrode boiler is at a higher temperature than the steam produced itself.

There is *no loss* in conversion efficiency, however, and simply cleaning the electrodes will restore full boiler capacity. There can be no heat build-up in the electrodes, therefore, no electrode burnout, and no danger to the boiler itself.

How the Model CEJS works

Water from the lower part of the boiler is pumped by the recirculation pump (4) up the collection pipe (13) to the nozzle stock (7). The water is forced through the jets of the nozzle stock to strike the electrode target plate (8) creating an electrical current path (R1). The unevaporated water flows from the electrode through the nozzle plate (9) to strike the counter electrode (10), creating a second current path (R2). Control of the boiler output is accomplished by raising or lowering the control sleeve (11) which diverts the water from selected jets directly back to the lower portion of the boiler. The control sleeve is moved electrically by the control motorized drive system (5) which, in turn, is positioned by the electric motor according to boiler pressure and loaf control system. This control system will hold steam pressure and match boiler output to system requirements.

The stand-by heater (14) is used to maintain the water temperature at a pre-set level in order to reduce start-up time.

A proportioning feedwater regulator (not shown) maintains a constant water level in the boiler. A load monitoring system prevents the electric demand from exceeding boiler capacity and enables the boiler to be manually set at levels lower than its full kw rating.

The boiler is also controlled by an automatic demand control system.

To shut off the boiler simply stop the recirculation pump.

SELECTION TABLE FOR JET TYPE ELECTRODE STEAM BOILERS

Model No.	Max. KW at 125 psig			Lbs/Hr based on feed water at 212°F		
	6.9 KV	13.8 KV	25 KV	6.9 KV	13.8 KV	25 KV
600	1,500	6,000	7,500	5,050	20,400	25,500
900	2,250	9,000	9,400	7,550	30,600	32,000
1,200	3,000	12,000	12,400	10,100	40,800	42,160
1,800	4,500	18,000	18,800	15,100	61,200	64,000
2,400	6,000	24,000	28,800	20,150	81,600	96,000
3,000	7,500	30,000	32,000	25,200	102,000	108,800
3,600	9,000	36,000	37,600	30,200	122,400	127,900
4,200	10,500	42,000	47,000	35,300	142,800	160,000
5,000	-	-	53,000	-	-	180,200

Other voltages are available on request.

Performance

High Performance

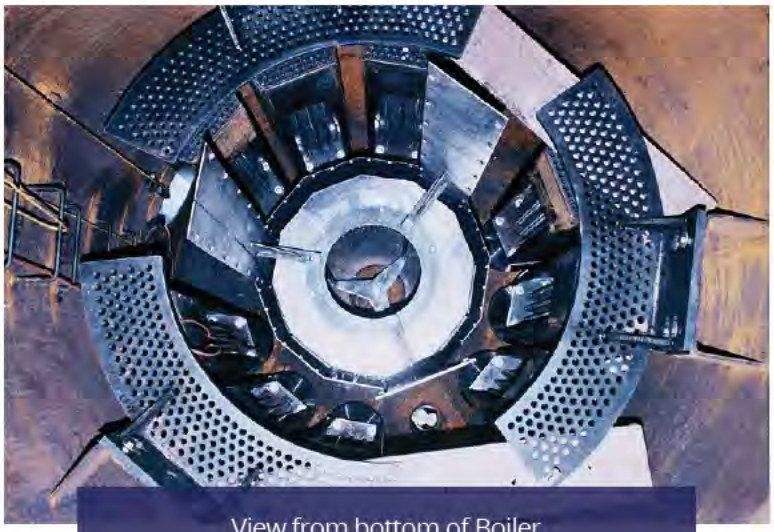
Converts almost 100% of the electrical energy into heat. Rapid response achieves full load within 15-20 minutes from cold start; within *one minute* from hot start. Automatic load and pressure controls provide linear control over the full output range, from 0 to 100% to match output to system requirements.

Economical Installation

Fuel lines, storage and handling equipment, economizers, and emission control equipment are not required, saving on capital expenditures.

Lower Operating Costs

Simple to operate and maintain, *all* electrical energy is converted to heat. Automatic controls reduce the requirement for dedicated operating personnel. No complex pollution or combustion control equipment to operate and maintain.



View from bottom of Boiler with 9 Electrode Boxes

Parallel Water Jets - from Nozzle Stock to Electrode Target Plates

Solves Energy Problems

For areas affected by allocations or interruptions of natural gas and costly oil supplies, electrode boilers provide a dependable source of steam. Offers a clean, easier-to-use alternative to fossil fuels. Allows users to take advantage of lower energy rates during daily or seasonal off-peak periods.

Safer Operations

No combustion hazards because there are no flames, fumes, fuel lines, or storage tanks. No low water danger since the current cannot flow without water. No problems with heat buildup or electrode burnout even if scaling should occur. Thermal shock is eliminated.

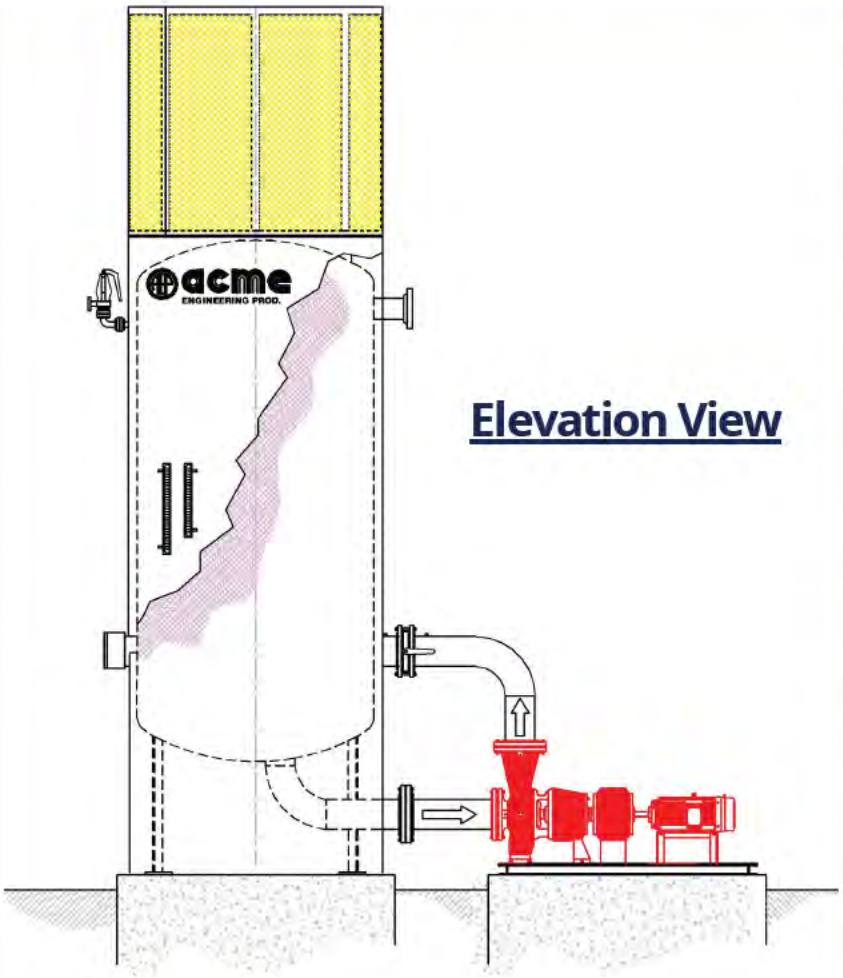
Minimal Maintenance

The absence of excessive temperatures and burnout assures long operating life. Electrode boilers have a minimum number of components and electrical controls. With fewer parts and no fuel residues, cleaning and maintenance requirements are reduced. A simple control system provides maximum reliability.

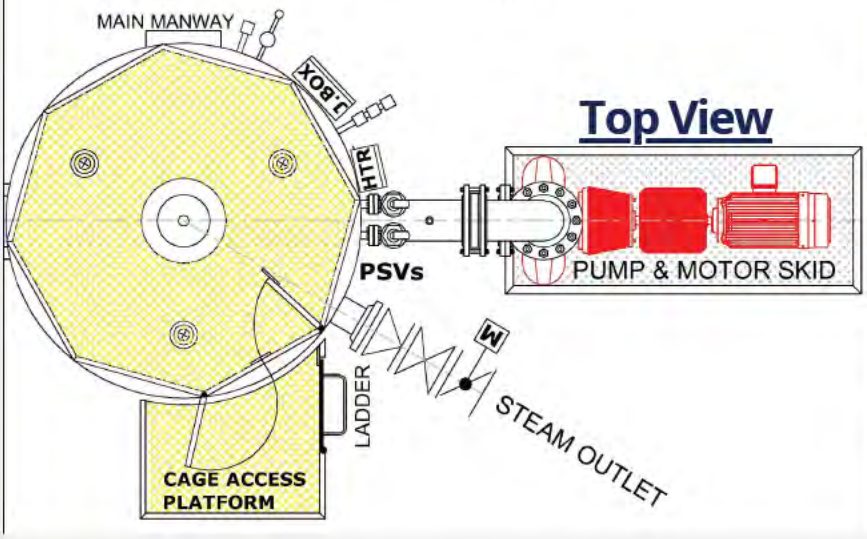
Pollution-Free

Without combustion, the operation of the CEJS boilers is quiet, clean, and emissions-free. Problems associated with other energy sources such as noise, fuel fumes, fly ash, large stacks, do not exist for ACME Electrode Boilers.

STANDARD EQUIPMENT FOR MODEL CEJS



Elevation View



Top View

Mechanical

- Pressure vessel, A.S.M.E. design, CRN - pressure vessel registration certificate.
- Manway.
- Sheet metal jacket and thermal insulation.
- Boiler recirculation pump.
- Water column and sight gauge.
- Cage surrounding high voltage connections.

Plumbing

- Steam valve, stop and check.
- Back pressure regulating valve.
- Safety valve(s).
- Surface blowdown valves.
- Chemical feed fitting.
- Modulating feedwater valve, with stop valve and check valve.
- Flow control valve for conductivity sampling line.
- Boiler blowdown valve(s).
- Boiler vent line.

Control

- Free standing control panel.
- Pre-programmed electronic processor.
- Shield position indicator HMI.
- Boiler pressure gauge.
- System pressure gauge.
- Operating pressure control.
- High-pressure limit.
- Water level controller.
- High *and* low water cut-offs.

Optional Items

- Interconnections with supply circuit switchgear.
- Special valves.
- Special insutrmentation.
- Chemical feed systems.
- Steam separators.
- Water treatment equipment.
- Higher steam pressures.
- Superheater.
- Separator.
- Deaerator.
- Feed water system.
- Blowdown tank.
- Heat-exchangers, steam to water.
- Steam injectors system.

In Canada
5540 Pare St.
Mount-Royal (Montreal)
Quebec H4P 2M1
Ph.: (514) 405-1478

VARKA

In U.S.A
2330 State Route 11
PO Box 460, PMB #10
Mooers, NY 12958
Ph.: (518) 236-5659

www.aepthermal.com - info@aepthermal.com - 1(888) 880-5323

EXHIBIT 6

CleaverBrooks, Model WB Electric Boiler

Model WB Electric Boiler

Hot Water Boiler

Model WB Electric Boiler

- Electric hot water boiler
- 12 to 3360 kW, up to 11.5 million Btu/hr
- Up to 600V
- 160, 200 & 250 psig
- No site emissions

Cleaver-Brooks electric boilers use electricity as an energy source for zero carbon footprint and zero site emissions, ideal for meeting emissions reduction or decarbonization goals. Electric boilers are also nearly 100% efficient, meaning all energy delivered to them is converted to steam or hot water.

NEW TIP SHEET: AVAILABLE NOW! →

TIP SHEET

Electric Project Sizing

Reference Projects

Step 1: Define the heating or process steam load. Below are a few conversions to assist you.

- **1 BTU = 0.000293 KW**
- **1 KW = 3412.14 BTU**
- **1 BHP = 9.8095 KW**

Step 2: Determine the Full Load Amps (FLA) of the boiler. This will help with sizing the required wiring and an appropriate breaker.

For this exercise, let's assume we have a heating load of 800 KW, and the available commercial voltage in the building is 480 V 3 phase at 60 Hz, a very common voltage found in most facilities in the United States.

FLA is calculated by dividing the total watts of the boiler by the voltage it will use:

- 800 KW is 800,000 Watts
- 800,000 Watts = 1,667 Amps
  This result is the full amperage the boiler would draw if connected to a single-phase circuit.
  Since we are using a 3-phase circuit, we need to divide this value by the square root of 3.
- 1,667/1.73 = 964 Amps

NEC Code requires that the wiring feeding the boiler be capable of handling 125% of the total load. By multiplying our FLA value of 964 x 1.25, we need to design a circuit rated for a total of 1,205 Amps.

- We can now choose the appropriate wire size for the installation using this simple calculator:
  http://wiresizecalculator.net/calculators/wiresize.htm
- For the breaker, we need to choose the closest available size from the list below:
  - 15 - 50 (in increments of 5)
  - 60 - 110 (in increments of 10)
  - 125 - 250 (in increments of 25)
  - 300 - 500 (in increments of 50)
  - 600 - 1200 (in increments of 100)
  - 1600, 2000, 2500, 3000, 4000, 5000, and 6000 Amps
- This installation would require a 1600 Amp breaker to satisfy NEC Code.
  We are ready to start purchasing equipment for this project.
  However, we are missing one last piece of the puzzle...Step 3!

WEBINAR

Trends in Building Decarbonization and the Role of Electric Boilers →

Electric and Electrode boilers are effective at providing space and process heating while being 100% emissions free and highly efficient at all operating points.

Product Overview

- Compact design and smaller footprint
- No site emissions
- Quiet operation with virtually no noise emissions
- Nearly 100% efficiency at all operating points
- Ease of maintenace with reduced complexity/number of moving parts
- All units are fully packaged and ready for installation

The Cleaver-Brooks Model WB is an immersion-element hot water boiler with a vertical, insulated vessel. This boiler is designed for the heavy-duty, continuous demand of commercial and industrial applications. Vessel sizes range from 12" to 42" diameter with an output spanning 12 kW to 3,360 kW. A typical Model WB boiler system includes operating controls, elements, fuses, contactors, safety valve, and instrumentation.

Discover More

Education & Training

Cleaver-Brooks has a dedicated Training Department offering web-based programs, co-sponsored authorized representative regional programs, custom on-site programs at the customer’s facility, and programs held at Cleaver-Brooks facilities.

Learn More →

Genuine Parts

Purchasing Cleaver-Brooks Genuine Parts is the best way to keep your boiler system operating at peak performance. Our parts are precision-engineered to fit your boiler, and they are rigorously tested for quality to ensure your boiler runs safely and reliably.

Shop Now →

Rental Solutions & Services

Our rental solutions provide for: capacity increases, peak demand, plant or steam outages, equipment shutdown due to inspection, retrofit or repair, and redundancy or disaster response contingency plans.

Learn More →

221 Law St
Thomasville, GA 31792

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EXHIBIT 7

Thermon, HW Series II, Electric Hot Water Boiler From The Precision Boiler Family

THERMON'S HW SERIES II

ELECTRIC HOT WATER BOILER FROM THE PRECISION BOILER FAMILY

THERMON
PRECISION BOILERS

A RELIABLE, PRECISE ELECTRIC HOT WATER BOILER
BUILT FOR LARGER COMMERCIAL DEMANDS.

INTRODUCTION

HW SERIES II BOILER

Offering reliability, precision, and performance, the Model HW Series II Electric Hot Water Boiler delivers customizable heat controls while maintaining efficiency and long-lasting durability.

KEY FEATURES

Durable Construction: Heavy-duty 16-gauge cabinet and structural steel base ensure exceptional strength and longevity.

Precise Temperature Control: Sensor located in the outlet pipe allows for accurate temperature regulation.

Customizable Options: Optional features and trim available to meet specific design criteria.

Accurate Temperature Control: Outlet pipe sensor for precise regulation.

Spacious Control Cabinets: Ample room for additional options, color-coded wiring, and easy access for service.

Efficient Heating Elements: Corrosion-resistant Incoloy sheath, nickel-chromium wire, U-tube design, available in 1-phase and 3-phase, limited to 75 watts per square inch for long life.

80+ years' experience of producing electric boilers

Products produced in the U.S.A.

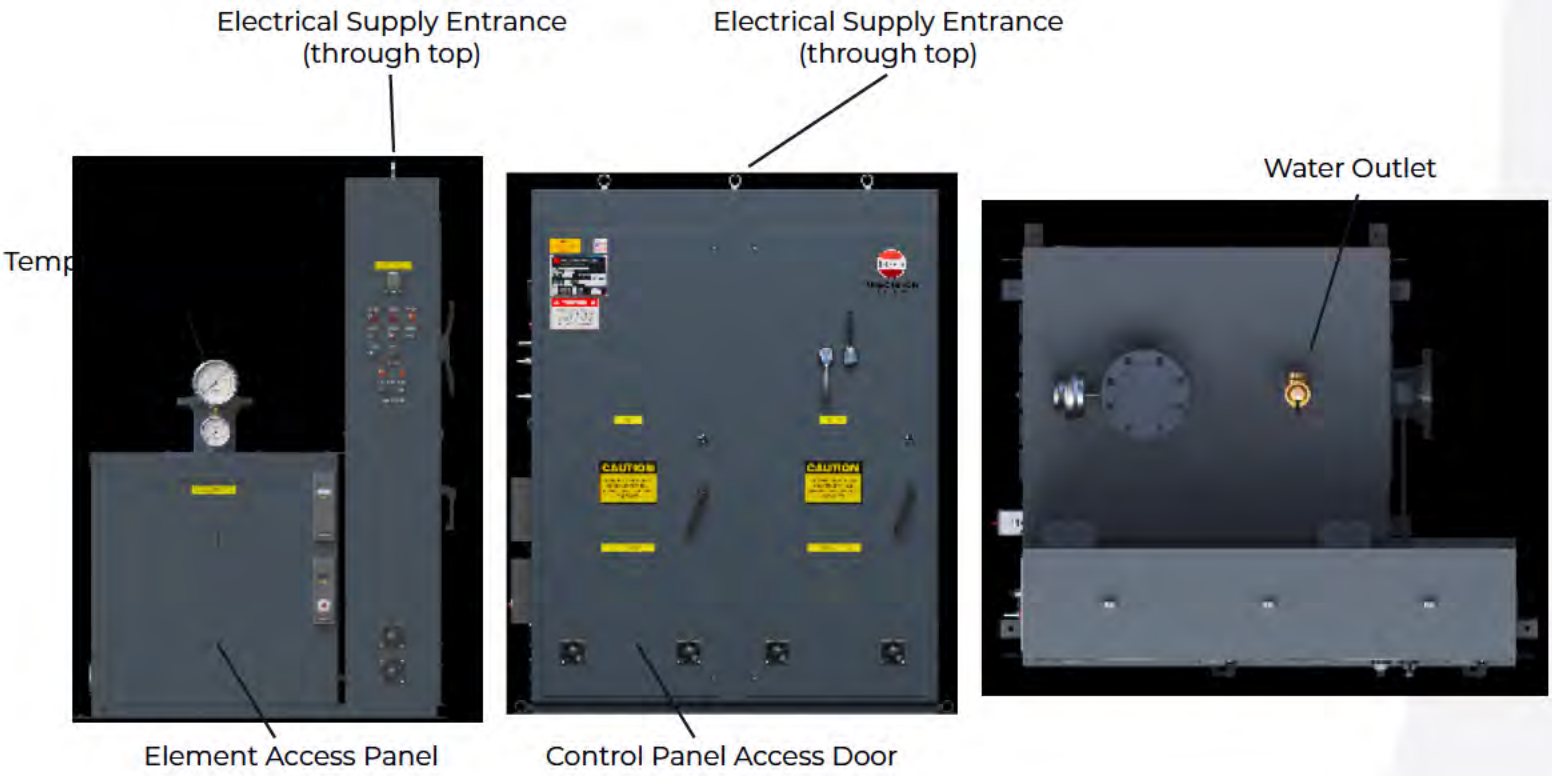
DESIGN ADVANTAGES

HW SERIES II BOILER

Precision Boilers product designs are engineered for durability, efficiency, and quality performance. Specifically crafted to deliver consistent temperature control in larger commercial applications, the HW Series II meets industry standards for safety and reliability, with custom design options to meet specific criteria.

SPECIFICATIONS

- Hot Water from: 76-421 BHP
- BTUs/hr: 682-14,371 MBH
- kW Rating: up to 3,600kW
- Pressures: 150 max design PSIG
- Voltages: up to 600V



DESIGN ADVANTAGES

HW SERIES II BOILER

APPLICATIONS, MARKETS, AND FACILITIES

- Healthcare Facilities
- Manufacturing Plants
- Hotels
- Commercial Buildings
- Museums, Libraries, and Archival Facilities
- Laboratories and Cleanrooms
- Data Centers
- Pharmaceutical Manufacturing
- Pulp and Paper Production
- Textile Manufacturing
- Packaging Facilities
- Wood Furnishing Manufacturers
- Printers

STANDARD FEATURES AND ACCESSORIES

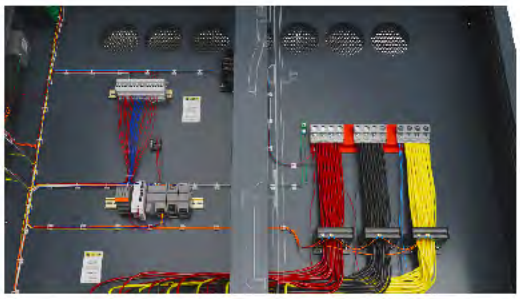
- National Board Registered Pressure Vessel (150 PSI / 250°F)
- Full Size Structural Steel Base
- Heavy Duty Steel Boiler Vessel Housing
- Flanged Inlet and Outlet (above 3")
- ASME Safety Relief Valve(s)
- Pressure Gauge w/ Cock
- Digial Electronic Temperature Readou
- Full-Port Drain Valve
- Incoloy Sheathed Elements @ 75 WSI
- Progressive Step Sequencing Control
- Integral Electric Control Panel with Ke
- Internal Branch Circuit Fusing
- Magnetic Contractors rated 500,000 C
- Main Supply Circuit Lugs
- 120 Volt Fused Control Transformer
- On/Off Switch with Pilot Light
- Status Pilot Light for each step
- Manual Reset Probe-type Low Water Cut-Off with Pilot Light and Test Circuit (>117 kW)
- Two Adjustable High Limit Cut-offs: (1) Auto Reset, (1) Manual Reset
- Automatic Temperature with Digital Temperature Readout
- Manual Limit Toggle Switches (one per step)
- NEMA 12 Cabinet Rating
- Emergency Stop, On-board Alarm and Flow Switch

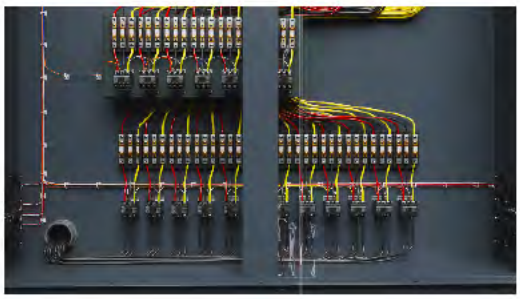
DESIGN ADVANTAGES

HW SERIES II BOILER

OPTIONAL EQUIPMENT AND ACCESSORIES

- Non-Fused Disconnect
- Local/Remote Switch (to accomodate BAS Analog Fused Disconnect or Automatic Breaker Control Signal)
- Shunt Trip Circuit Interrupter
- Flow Switch (Installed)
- Ground Fault Detection System
- Auto Air Vent (Installed)
- Multi-Function Power and Energy Meter
- Auxiliary Low Water Cut-Off (Float or Probe type)
- Time Clock (24 hour or 7 day)
- Oversize Inlet/Outlet Connections
- Safety Door Interlock
- Low Temperature Switch/Alarm
- Design Pressures Above 150 PSI
- Remote Reset of Setpoint
- Stainless Steel Construction (210°F) for Deionized Water (to accomodate BAS Analog Reset Signal)
- Outdoor Reset Control
- PLC and Other Interface Provisions (Consult Factory)





Contact Precision Boilers for customized options to meet your specific requirements.

WHY CHOOSE THERMON?

HW SERIES II BOILER

Thermon is a diversified technology company and a global leader in industrial process heating, temperature maintenance, environmental monitoring, and temporary power distribution solutions. We deliver engineered solutions that enhance operational awareness, safety, reliability, and efficiency to deliver the lowest total cost of ownership.

Thermon offers over 250 products, software and services across multiple brands, providing a range of offerings from boilers, transportation heaters, and liquid load banks to tubing bundles and heat trace. We are the silent guardians of critical infrastructure. From the relentless demands of chemical plants and the intricate networks of rail and transit to the vital pulse of power generation, we innovate solutions that ensure optimal operation, protect critical assets, and maximize efficiency.

We care deeply about the success of our customers, the well-being of our people, and the reliability of every product we design. This drives our unwavering commitment to safety and integrity in everything we do. Through collaboration, we unite a rich legacy of expertise with a trusted global team, partnering side-by-side with our customers. We transfer the warmth needed to make life work.

LIMITED WARRANTY

HW SERIES II BOILER

Thermon's Precision Boilers Family warrants all electrical components (except pilot lights and fuses), pressure vessel and heating elements, if found defective in workmanship or material while under normal use and service within the first year of operation or until 18 months after shipment from Precision's factory, whichever occurs first, after authorized return by purchaser to Precision (at purchaser's expense) and after examination discloses to Precision's reasonable satisfaction to be defective. The repair or replacement of defective parts will be made by Precision without charge. Precision will not be held responsible for any field charges in connection with the removal or replacement of allegedly defective parts, nor for incidental or consequential damages. This guarantee does not include damage resulting from unsuitable water.

NOTE: In pursuing our policy of continuous development of products,

Precision reserves the right to vary any detail in this bulletin without notice.

Other Thermon products: *https://thermon.com/products/*

For more information, email ***info@thermon.com***

EXHIBIT 8

AEP Thermal, Inc., Immersed Electrode High Voltage Hot Water Boiler

A.E.P. - THERMAL INC.

acmetherm®

IMMERSED ELECTRODE HOT WATER BOILER

CEJW SERIES

REV. 2023 - 08

Immersed Electrode High Voltage Hot Water Boiler

CEJW Immersed Electrode Hot Water Boilers for Large Applications

These immersed electrode boilers have unlimited application possibilities wherever a need for large hot water process or space heating exists. A partial list of possible uses includes:

- **Office and apartment buildings**
- **Hospitals, schools, hotels, motels**
- **Food processing Plants**
- **Clothing and textiles plants**
- **Industrial plants**
- **Plastic and chemical plants**
- **Mining Operations**
- **Power plants for District Heating**
- **Car Manufacturing**

WHY CHOOSE A HIGH VOLTAGE BOILER?

OUTPUT MATCHES FUEL BURNING BOILERS

Due to considerable advances in High Voltage electric boiler technology for heat or power generation, Immersed Electrode Boilers can match the capacity of large gas or oil-fired boilers (up to 60 MW) while occupying a much smaller footprint.

LOWER OPERATING COSTS

Immersed Electrode Boilers are simple to operate and maintain with no complex pollution or combustion control equipment required. Users can also take advantage of lower energy rates during daily or seasonal off-peak periods.

ECONOMICAL INSTALLATION

Operating at distribution voltages, electrode boilers eliminate the need for fuel lines, storage and handling equipment, economizers and emission control equipment, saving on capital expenditures.

MINIMAL MAINTENANCE

Immersed Electrode Heating Loops have a minimum number of components, equipment and electrical controls, resulting in fewer parts to clean and maintain. They are not affected by the water quality on the process flow as the boiler heating loop is isolated from the existing heating water system.

ENVIRONMENTALLY FRIENDLY

Without combustion, the operations of Immersed Electrode Boilers are quiet, clean and emissions free. Problems associated with other energy sources such as noise, fuel fumes, fly ash and large stacks, do not exist.

CEJW IMMERSED ELECTRODE HOT WATER BOILERS FEATURES:

- Capacity range: 2500 to 68,000 KW
- Electric Power Supply Voltage : 4160 to 25000 V
- Maximum Operating Temperature for Standard Models: 180 °C (360 ° F)
- Operating pressure: 3 to 14.5 bar (50 to 200 psi)
- Power Feeds (Current Passage) assembled and certified for 42000 V and 16 bar (230 psi) for any operating voltage
- Fast Response: 0 to 100 % capacity in:
  Hot State: 1 minute
  Cold to Hot state : 15 to 25 minutes (depends on the size)
- Economical even for capacities between 2 to 6 MW
- Simple controls
- Can be added to existing systems and suitable for optional water storage facilities
- Ability to take advantage of low off-peak electricity rates and demand swings

PERFORMANCE

CEJW PERFORMANCE & BENEFITS

CEJW boilers convert virtually 100% of the electrical energy into heat. Automatic load and temperature controls provide stepless control over an output range from 10 to 100%.

ECONOMICAL INSTALLATION

Operating at distribution voltages, CEJW boilers eliminate the need for fuel lines, storage and handling equipment, economizers and emission control equipment, saving on capital expenditures. Also, in the case of using Electric Boiler, they eliminate the need for a stepdown transformer.

LOWER OPERATING COSTS

The CEJW boilers are easy to operate. Automatic controls (PLC) reduce the need for operating and supervisory personnel. The cost of water treatment is practically eliminated as the system is isolated. The water loop is initially filled with water at the selected conductivity and quality. Automatic venting ensures full water filling of the vessel.

For areas affected by allocations or interruptions of natural gas and costly oil, our CEJW boilers provide an economical alternate solution, providing a dependable source of hot water. They also allow users to take advantage of lower energy rates during daily or seasonal off-peak periods or satisfying the swing demand.

SAFER OPERATION

There are no combustion hazards because there are no flames, fumes, fuel lines or fuel storage tanks. There is no low water danger since the current cannot flow without water and there are no problems with heat buildup or electrode burnout even if scaling should occur. Thermal shock is eliminated. Electrically safe due to a grounded pressure vessel. A safety enclosure around boiler is not required and expensive isolating piping connections are not required.

MINIMAL MAINTENANCE

Long-life electrodes are cooled by water jets produced by an integrated loop pump. Acme CEJW boilers having a minimum number of components and electrical controls, providing maximum reliability. Without fuels, cleaning and maintenance are reduced.

ENVIRONMENTALLY FRIENDLY

Without combustion, the operation of the CEJW boiler is quiet, clean and emission-free. Problems associated with other energy sources such as noise, fuel fumes, fly ash, large stacks, do not exist with the CEJW boiler.

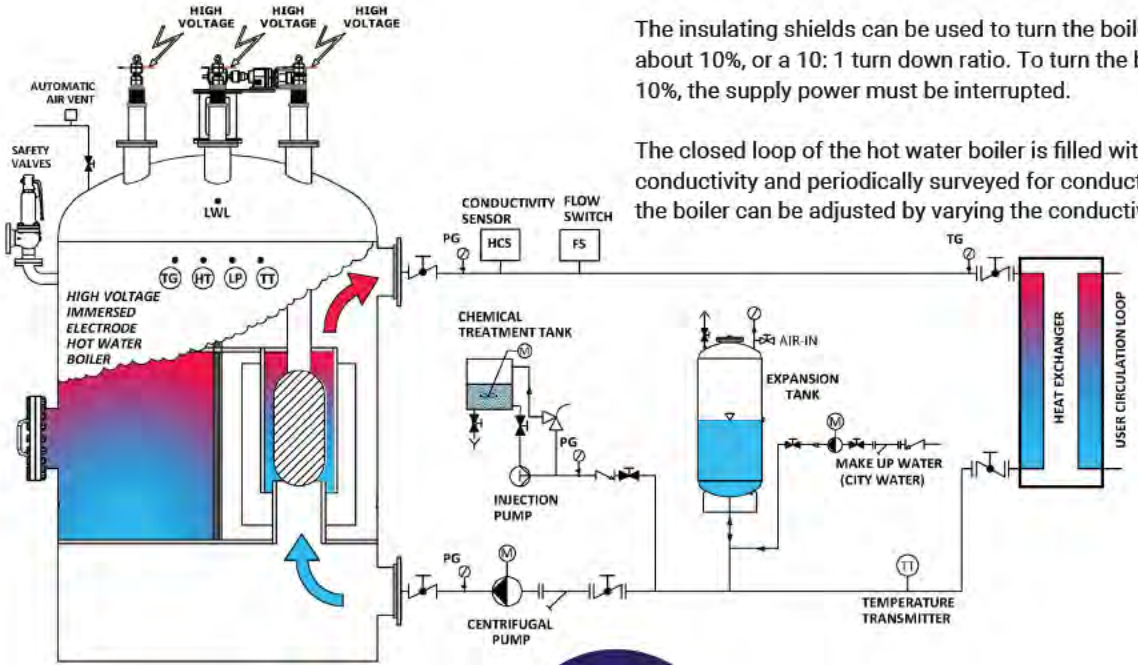
OPERATION

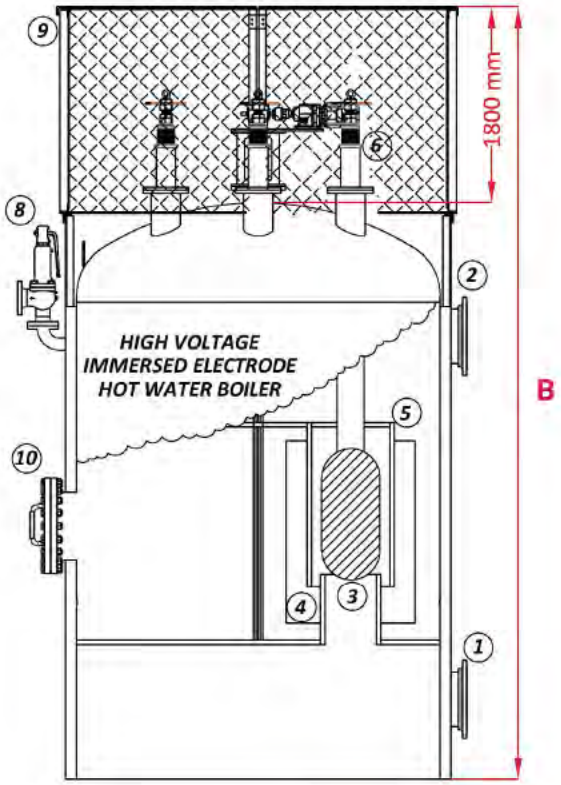
HOW THE MODEL CEJW WORKS

The CEJW operates flooded with water at the selected conductivity. A motorized drive system is used to interpose a concentric insulating counter electrode between the electrode and the neutral counter electrode. The more direct the exposure between neutral shield and the electrode, the greater the current draw (amperage) and more hot water is produced. As the insulating shield is moved between the electrode and neutral, the current path length and output is changed. Hot water is generated in the space between the electrodes and neutral counter electrodes and escapes into the vessel.

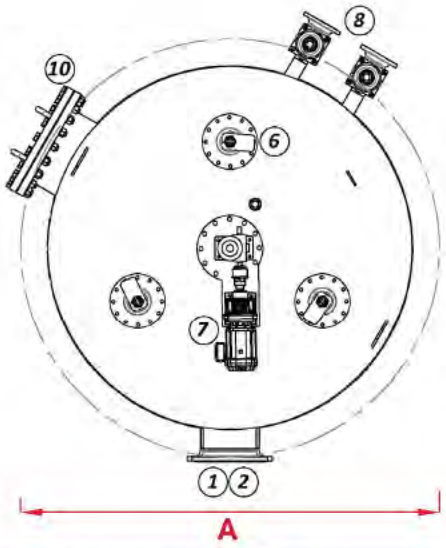
The insulating shields can be used to turn the boiler output down to about 10%, or a 10: 1 turn down ratio. To turn the boiler down below 10%, the supply power must be interrupted.

The closed loop of the hot water boiler is filled with water at selected conductivity and periodically surveyed for conductivity. The capacity of the boiler can be adjusted by varying the conductivity.





1	WATER INLET	6	POWER FEED
2	WATER OUTLET	7	MOTORIZED DRIVE SYSTEM
3	ELECTRODE	8	PRESSURE SAFETY VALVES
4	COUNTER ELECTRODE	9	SAFETY CAGE
5	SHIELD	10	MANHOLE



STANDAR CEJW HOT WATER BOILER

MODEL	VOLTAGE (KV)	POWER (KW)	BOILER DIA. A mm(Inch)	BOILER HEIGHT B mm (Inch)	INITIAL CLEARANCE HEIGHT FOR POWER FEED INSERTION mm(Inch)	PUMP FLOW RATE m³/hr (gpm)
CEJW-6	4.16	2500	2100 (83")	4200 (165")	4700 (185")	300 (1300)
	6.9	4200				
	10	6000				
	13.8 - 25	7000				
CEJW-8	4.16	3500	2200 (86")	4500 (177")	5200 (205")	350 (1550)
	6.9	5700				
	10	8000				
	13.8 - 25	9000				
CEJW-10	4.16	4200	2550 (100")	4700 (185")	5500 (215")	480 (2100)
	6.9	7000				
	10	10000				
	13.8 - 25	11000				
CEJW-15	4.16	7500	2550 (100")	5300 (208")	6700 (263")	650 (2850)
	6.9	12000				
	10	15000				
	13.8 - 25	17000				
CEJW-20	4.16	9000	2900 (115")	5800 (228")	7400 (290")	850 (1700)
	6.9	15000				
	10	20000				
	13.8 - 25	22000				
CEJW-30	4.16	15000	3100 (122")	5850 (230")	7600 (300")	1300 (5700)
	6.9	25000				
	10	30000				
	13.8 - 25	33000				
CEJW-40	4.16	18000	3200 (126")	6800 (267")	9000 (355")	1700 (7500)
	6.9	30000				
	10	40000				
	13.8 - 25	45000				
CEJW-60	4.16	33000	3950 (155")	6800 (267")	9000 (355")	2550 (11200)
	6.9	54000				
	10	60000				
	13.8 - 25	68000				

This information provided is a general description of the CEJW. All specifications are subject to change without notice. Installation, maintenance, operating and any other instructions furnished with the equipment must be carefully followed by installers, owners and users.

CEJW HEATING LOOP COMPONENTS FOR STANDARD MODELS

BOILER

- Pressure vessel, ASME (Section I or IV) design, CRN/U stamp pressure vessel registration certificate or CE / PED required
- Complete assembled Power feeds tested and certified for 16 bar (230 psi) and 42 KV
- Boiler actuator and capacity control system
- Large DN 500 (20") Manhole
- Sheet metal jacket and 100 mm (4") ceramic fiber thermal insulation
- Safety cage surrounding high voltage connections
- Safety valve(s)
- Manual drain (initial fill-up) valve
- Automatic air vent

CIRCULATION PUMP

Simplex or duplex pumps circulate water in the loop. Flow of each pump is determined by the cooling requirements of the electrodes therefore ensuring their long life and minimizing wear. Air cooled pump skids include TEFC motors, usually at building voltage controlled from the System Control Panel. Pressure loss in the loop determines the head of the pump at the required flow.

HEAT EXCHANGER

Completes heating system loop including boiler and pump. Stainless Steel Plate type construction with standard steel plates individually removable on rod. Primary circuit design method is to pump flow and heat transfer of boiler heating capacity. Secondary circuit water heats building, plant or storage facilities transferring heating boiler capacity.

EXPANSION TANK

Expansion tank based on total water content of the loop and its operating pressure.

ELECTRICAL

- Ground terminals
- Ground Fault Detection Relay
- Power feeds connection busbars
- Electrodes
- Circulation pump motor starter or VFD

GUARANTEE

All our Immersed Electrode Boilers are guaranteed for one year in operation or 18 months after shipment against defective workmanship and material. Guarantee limited to replacement of defective parts only, when returned, prepaid, to the factory. Copy of guarantee available on request.

CHEMICAL FEED WATER TANK AND INJECTION PUMP

All boilers require adequate water quality as determined by conductivity, pH, softness and chemical content. The type and degree of water treatment will be determined by local water quality, type of boiler, nature of operation, and quantity of raw make-up water required.

Chemical Treatment tank equipped with a mixer and an injection pump to add chemical to heating loop water.

INSTRUMENTS AND CONTROL

- Free standing control panel
- Pre-programmed electronic processor (PLC) and HMI on the panel
- Conductivity sensor to continuously monitor and control the conductivity of the Heating Loop Water
- Flow switch to continuously monitor the circulation pump water flow and interrupt the power in case of no water
- Two Temperature transmitters to control the maximum operating temperature and the boiler capacity
- Low water level
- High Temperature sensor
- Pressure/ Temperature gauges
- Proximity Sensors for shield traveling limits and position
- Remote Supervision (optional)

ACCESSORIES

- Isolating valves for boiler, heat-exchanger and centrifugal pump
- Piping for the loop
- Y strainer, located on the pump suction pipe
- Filling water system, connected to the Expansion tank-includes pump, Y strainer, check valve and isolating valves

ACCESSORIES FOR CEJW- OUT OF ACME SCOPE

- Circuit switchgear
- Water treatment equipment
- Thermal Storage: Can be incorporated as part of the heating system. It will store the hot water produced during periods of low demand and low cost and use it at advantageous time

ELECTRICAL REQUIREMENTS

CEJW boilers can be connected directly to the high voltage power distribution network. Any voltage up to 13.8 KV, 3 phase, 3 wires and centerline grounded line. Any voltages more than 13.8 KV requires a 4 wire distribution. The boiler shell and cage must be grounded to the building steel and ground mat.

In Canada
5540 Pare St.
Mount-Royal (Montreal)
Quebec H4P 2M1
Ph.: (514) 405-1478

In U.S.A
2330 State Route 11
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Mooers, NY 12958
Ph.: (518) 236-5659

www.aepthermal.com - info@aepthermal.com - 1(888) 880-5323

EXHIBIT 9

GPW Law, McLouth Steel, Trenton Plant

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William J. Moorhead (Of Counsel) (https://gpwlaw.com/attorney/william-j-moorhead-of-counsel/)
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LIVE CHAT

Online Agent

McLouth Steel, Trenton Plant

In 1948, McLouth Steel started its $100 million expansion program by purchasing riverfront property in Trenton, MI. Construction on the first major construction program was started soon afterward. The site was laid out and four sixty-ton electric arc furnaces were installed. Soaking pits, a blooming mill, a Steckel mill, a down-coiler and finishing equipment were installed. McLouth was soon established as a growing factor in the marketplace. The first ingots were poured in 1949.

A few years later in 1954, the Trenton Plant was dedicated, and McLouth Steel became able to produce iron as an integrated steel mill. Number One blast furnace was constructed with a capacity of 1250 tons a day. The three original 60-ton basic oxygen furnace (BOF) vessels were installed and McLouth became the first plant in North America to make steel via the basic oxygen process. Adding to the melt shop were two 200-ton electric arc furnaces. The reversing Steckel mill was replaced by a six-stand continuous 60-inch (1,500 mm) hot strip rolling mill and a roughing stand was added to compliment the blooming mill. More soaking pits were installed as well as a plant to supply the BOP with oxygen. Two pickle lines were also added along with the slitters.

1958 saw another major expansion of the plant. A new blast furnace was constructed (Number 2), two 110-ton BOP vessels, and the related support equipment for the BOP and blast furnaces also had their capacity increased. Gas cleaning systems were installed for the melt shop as well.

Two Rust slab reheat furnaces were installed to handle stainless steel, as well as the massive grinder and slab unpilers. The grinders, unpilers, and the pusher/bumper units for the two furnaces were supplied by Composite Forgings, Inc.

Between 1960 and 1964 one more 110-ton BOP vessel was added bringing the 110 ton vessel count to three. McLouth also became the first company to use computer controls on a hot strip mill on November 1, 1962, using a GE 312 computer. Significantly, the first “straight stick” slab caster was installed during this period. It was the first continuous caster in the United States.

Profitable operations as well as market demand prompted a major commitment to build a Continuous Casting department in 1967 with the announcement of four curved mold continuous casting strands and six lines of three induction slab reheaters. Two additional 110-ton BOP vessels were also added to replace old and obsolete equipment (the 60 ton vessels). With these improvements to McLouth’s steel making process, McLouth became the first steel mill to eventually produce 100% of its product by the continuous casting process, which added significantly to the efficiency of the operations and improved the quality of the finished product. Ladles were moved by overhead bridge cranes to the casting machines which can handle two at a time.

The record slab length for the plant was between May 9–11, 1972. The slab was 44″ wide and 9,972 feet (3,039 m) long, total weight was around 8,500 tons from 75 ladles.

Iron & Steelmaking Assets

The Trenton plant was a pioneer in steel technology, notably housing the first successful Basic Oxygen Process shop in the United States.

Iron Making

- Blast Furnaces: Two furnaces (#1 and #2) built by Arthur McKee Co. in 1954 and 1958.
- Sinter Plant: Phased out in 1969 due to inefficiency.
- Ore Infrastructure: Three Dravo Corp ore bridges (12-ton capacity) and three ore yards.

Steelmaking Shops

- Oxygen Process (OP) Shops:
  - OP 1: Three 60-ton vessels (1954). Dismantled in 1968.
  - OP 2: Five vessels (110-ton) built by PECOR. Limited in size by existing low ceilings.
- Electric Furnaces: Used to melt scrap steel.
  - Melt Shop: Originally four 60-ton units (1948); replaced by two 200-ton units (1954).
  - O.D. Shop: Installed in 1977 for argon oxygen decarburization. Later converted to a ladle metallurgy station.

Continuous Casting

- Pilot Plant (1963): The first straight-stick slab casting machine in America.
- Concast Department (1968): Four low-profile curved mold machines.

Rolling & Finishing

Once the steel was cast, it moved through reheating and rolling to reach its final dimensions.

Hot Strip Mill & Reheating

- Soaking Pits: 5 two-hole batteries used to heat ingots to 2400°F.
- Reheat Furnaces: Two conventional gas furnaces (125 tons/hr).
- Induction Furnaces: 18 Ajax Magnethermic furnaces installed 1968–1969.
- Walking Beam Furnace: Added in 1985 (350 tons/hr).

Blooming Mill

- Primary reduction. After steel has been cast into ingots, the blooming mill reduces through heat and pressure.

Roughing Mill

- Secondary Reduction. Roughs out the basic shape of the final product.

Finishing

- Pickle Line: 553-foot sulfuric acid line for cleaning coils.
- Slitters: Five separate lines (built 1948–1964) to cut steel to specific widths.

Asbestos Exposure

There are numerous departments and occupations that experienced heavy asbestos exposure at the McLouth Steel Plants were the Boilerhouse/Powerhouse, Air Separations, Blast Furnaces, OP, Soaking Pits, Rust Reheat Furnaces, and Ajax Furnace areas.

Boilerhouse/Powerhouse:

There is high asbestos exposure to asbestos covered steam pipes, block insulation and boiler jackets.

- Boilerhouse/Powerhouse Job Descriptions:
- Boiler operator: Inspects and operates boilers.
- Water Tender: Works under the direction of boiler operator, monitors the high-pressure steam equipment.
- Boiler Cleaner: Assists in cleaning inside and outside of steam boilers and auxiliary equipment.
- Laborers: Helped in clean-up work after tradesmen.
- Mechanical Repairmen: Responsible for multi trade work including turbine repair, pipefitting, and mechanic work.
- Pipefitters: maintains steamlines and worked with turbine repairmen on big jobs.
- Turbine Repairmen: Maintained boilers and turbines – covered turbines, pumps, drums, and feed pump heads. Also removed boiler jackets and helped pipefitters tear-out and recover lines.

Blast Furnaces:

Iron ore pellets, scrap and limestone are melted into iron-ore at the blast furnaces. The iron-ore is transferred by hot metal cars to the Oxygen Process and Electric Furnace where it is converted to steel.

Blast Furnaces Job Classifications:

- Keeper: Taps iron from furnace; maintains tap hole troughs, and runners.
- Keeper Helper: Assists in tapping iron from furnace, assists keeper.
- Laborer: Clean up work.
- Larryman: operates larrycar of ore, limestone, and scrap to charge the furnace.
- Stove Tender: Adjusts and regulates heating and changing of blast furnace stoves.
- Pipefitter: Maintains pipelines.
- Bricklayer: Maintains furnace lining, hot metal cars, troughs, and runners.

Box Anneal Furnaces:

Reheat the coils before rolling. The annealing process tempers the steel to meet the specifications of the purchaser. These were located at McLouth's Gibraltar Plant.

Job Classifications:

- Annealer – operates annealing furnaces.
- Crane Hooker – hooks crane to top of furnaces.
- Crane Operator – operates crane to lift furnace covers.
- Pipefitter – maintains pipes.

- Bricklayer – rebuilds furnaces.
- Laborer – clean up work.

Soaking Pits:

They are deep pits that are rectangular in shape. At the soaking pits the steel ingots reheated by gas to 2400 degrees. When the steel leaves the soaking pits, it is rolled, coiled or finished.

Job Classifications:

- Bricklayer: rebuilt work on soaking pits walls and floor.
- Laborer: Tear-out work on soaking pits.
- Pipefitter: Repair of gas piping.
- Nozzleman: Spray fireproofing of soaking pits.
- Crane Operator: Lifts steel slabs in and out of the soaking pits.

Slab Furnaces:

The slab furnaces reheat the slabs in order to go through the roughing and finishing mills.

Job Classifications

- Pipefitter: Maintains pipes in furnace area.
- Bricklayer: Repairs furnace lining and patch repair work.
- Laborer: tear out of furnace lining for rebuild work.
- Heater: operates slab furnaces.
- Heater helper: assists heater in operation and maintenance of furnaces.

Other areas of exposure at the McLouth Steel Trenton Plant:

- Ladels: The ladels were relined in a ladel reline area, next to the open-hearth furnaces. Castable, brick and mortar were used in the relines. Some of the castable and possibly some of the mortar may have been asbestos containing.
- Hot Metal Cars: The hot metal cars or bottle cars transfer the molten iron to the OP furnaces. Brick, mortar, and ramming material was used to line them.
- Pickler: The steel is dipped in vats or tanks of acid at the pickler. Brick and mortar were used on the tanks. The acid lines are high temperature lines that are made from and covered with asbestos. The acid changes the pipes and they had to be replaced.
- Bar Mill Furnaces: There is one furnace at the 10” Bar Mill and one furnace at the 14” Bar Mill furnace. These are reheat furnaces – brick and mortar were used.
- Hot Strip: There was one Rolling Mills slab furnaces that reheat slabs which are in turn rolled into steel sheets and coils.
- Mold Yards: There are mold yards at the Trenton mill. The steel is poured into ingot molds at the OP and Electric Furnaces. The molds had an asbestos insert, which was prepared in

the mold yards. There also were two different types of hot tops were board/sheets or brick lined covers.

Other occupations exposed to asbestos:

- Maintenance Foreman and Supervisors: They schedule and supervise the maintenance and repair of the buildings and equipment.
- First Line Supervisors/Managers Production and Operating Workers: They directly supervise and coordinate production and operations employees (Precision Workers, Inspectors, Machine Setters and Operators, Assemblers, Fabricators, and Plant and System Operators.
- Maintenance: Construction and Millwrights, Bricklayers, Electricians, Insulators, Machinists, Oilers, Painters, Pipefitters, Welders, and other trades. They construct, maintain, and repair the buildings and equipment throughout the plant.
- Heavy/Mobile Equipment Repair: Industrial Mechanics maintained and repaired Kress Carriers, payloaders, fork trucks, dump trucks, tow motors, hoists, and other equipment
- Material Handling: Hi-Lo Operators, Crane Operators, Equipment Operators, Laborers, Sludge Operators and Tractor Operators. They handle and move the raw materials, steel, and equipment for the mill.
- Transportation: Railroad Laborers, Switchman and Engineers operated the locomotives for transporting molten steel, Ingot molds, and other materials.
- Receiving and Shipping: They receive and ship materials for the various plants and departments.

Asbestos exposures at McLouth Steel came from a number of sources including asbestos containing blankets, brick insulation, brakes, clothing, electrical products, fireproofing, gaskets, granite, hot tops, furnace cement, insulating cement, pipecovering, refractory insulation and sideboards.

In addition to the Trenton Plant, there were numerous departments and occupations that experienced heavy asbestos exposure, at McLouth's Detroit and Gibraltar Plants.

Experienced Asbestos Lawyers for McLouth Steel Workers in Detroit, Trenton, and Gibraltar

If you or a loved one have questions regarding asbestos exposure at McLouth Steel or anywhere in Detroit, Trenton or Gibraltar, Michigan, we have Michigan based and licensed lawyers with over 50 combined years of experience that would be able to assist you. John Kelsey and John Ponnerville are Asbestos & Mesothelioma Attorneys with Goldberg Persky & White. They are very knowledgeable in regards to asbestos exposure at McLouth Steel,

Mesothelioma and the other asbestos diseases caused by asbestos exposure. They have represented many individuals with mesothelioma, lung cancer or asbestosis in Wayne County Circuit Court for over 35 years. If you have any questions concerning your exposure to asbestos and mesothelioma at McLouth Steel in Detroit, Gibraltar, or Trenton MI call one of our Michigan Lawyers. Our Michigan-based mesothelioma lawyers may be able to give guidance if you were exposed to asbestos in Detroit, Gibraltar, or Trenton, Michigan.

T

Why does it matter that McLouth Steel Detroit, Gibraltar or Trenton, Michigan is in our jobsites database?

It matters that McLouth Steel Detroit, Gibraltar, or Trenton, Michigan, is in our jobsites database because familiarity with specific work environments is crucial for successfully pursuing an asbestos claim.

Here's why:

- Knowledge of Work Environments: Lawyers need to understand the specific job sites where asbestos exposure occurred. This includes knowing the layout of the facilities, the types of tasks performed, and the duration of employment.
- Identification of Responsible Parties: Understanding the companies that employed individuals at McLouth Steel and the products they used is essential for identifying liable parties in asbestos-related claims. This includes both the manufacturers of asbestos-containing products and the companies that used them.
- Supporting Evidence: Access to depositions, testimonies of other asbestos disease victims, and documentation from the plant and defendants can provide critical evidence to support a claim. This evidence helps establish the link between asbestos exposure at McLouth Steel and the resulting health effects.
- Legal Expertise and Resources: With over 40 years of experience in asbestos litigation, our firm has developed a comprehensive knowledge base that includes company diagrams, invoices, memos, product packaging, expert testimonies, and scientific literature. This wealth of resources strengthens our ability to effectively represent clients in asbestos-related cases.

By having McLouth Steel Detroit, Gibraltar, or Trenton, Michigan, in our jobsites database, we can offer informed and strategic legal representation tailored to the specific circumstances of each client's case.

If you have been diagnosed with mesothelioma you should immediately speak with an experienced Michigan-based lawyer to preserve your legal rights as this is a time sensitive matter and knowing the facts will help you make the best medical and legal decisions possible

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and help you recover financial compensation for medical expenses, lost wages and pain and suffering.

Michigan Job Sites

- General Motors Foundry (https://gpwlaw.com/general-motors-foundry/)
- Mclouth Steel Trenton Plant (https://gpwlaw.com/mclouth-steel-trenton-plant/)
- McLouth Steel Company Gibraltar (https://gpwlaw.com/mclouth-steel-company-gibraltar/)
- McLouth Steel Detroit Plant (https://gpwlaw.com/mclouth-steel-detroit-plant/)
- Ford Rouge Steel Division (https://gpwlaw.com/ford-rouge-steel-division/)
- Great Lakes Steel Zug Island (https://gpwlaw.com/great-lakes-steel-zug-island/)
- Great Lakes Steel, National Steel Division (https://gpwlaw.com/national-steel-division/)
- Fletcher Paper Mill (https://gpwlaw.com/fletcher-paper-mill/)
- Ford Rouge Plant Dearborn (https://gpwlaw.com/ford-rouge-plant-dearborn/)
- Escanaba Pulp and Paper Mill (https://gpwlaw.com/escanaba-pulp-and-paper-mill/)
- Packaging Corporation of America Paper (https://gpwlaw.com/packaging-corporation-of-america-paper/)
- Smurfit-Stone Container Corporation (https://gpwlaw.com/smurfit-stone-container-corporation/)
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EXHIBIT 10

SELIT Induction Heating Systems, Induction furnaces for hot rolling mills

ENERGY EFFICIENCY AT THE SERVICE OF STEELWORKS

INDUCTION FURNACES FOR HOT ROLLING MILLS

At the beginning of the 2000s, SELIT collaborated with ARVEDI steel mills in the development of continuous casting technology in flat laminates, called ARVEDI ESP, establishing itself as the first world manufacturer to have created a 36.000kW – 10 kHz induction temperature recovery system able to raise and equalize the temperature of slabs during mill rolling.

Since then, SELIT has designed and built numerous induction heating systems for slabs up to 2000mm wide and from 100mm to 9mm thick. **SELIT always guarantees the maximum power of heating, even when there is a change in slab thickness, making it unique in the world.**

Thanks to the SELIT's system, it was possible to create the production line obtaining **an overall energy saving of 50%.**

CONTACT US

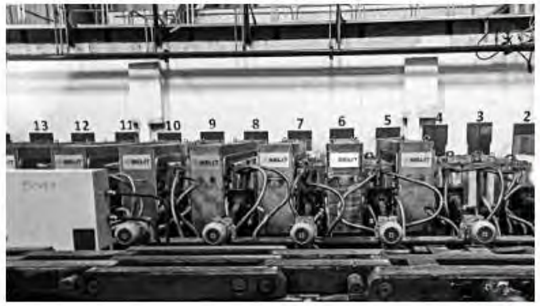

EXHIBIT 11

Foundry Management & Technology, Efficient, Reliable Large-Scale Induction Melting

MELT/POUR

Efficient, Reliable Large-Scale Induction Melting

Inductotherm commissions four 22,000-kw power supplies and 50-mt furnaces for melting steel 22,000-kW, 50-mt furnaces Coating plant for rebar

FMT Staff ▪ Aug. 11, 2016 ▪ 3 min read

Metalcasters know where to turn for expertise in plant and equipment design, and that expertise may transcend the typical industrial connections. Recently, the Inductotherm Group — widely celebrated for its foundry melting and pouring technologies — delivered a comprehensive, large-scale design for a manufacturer of commodity-grade steel products. In addition to demonstrating its technological capabilities, the project also illustrates the contractor's global scope, and the international demand for high-tech industrial expertise.

About the Author

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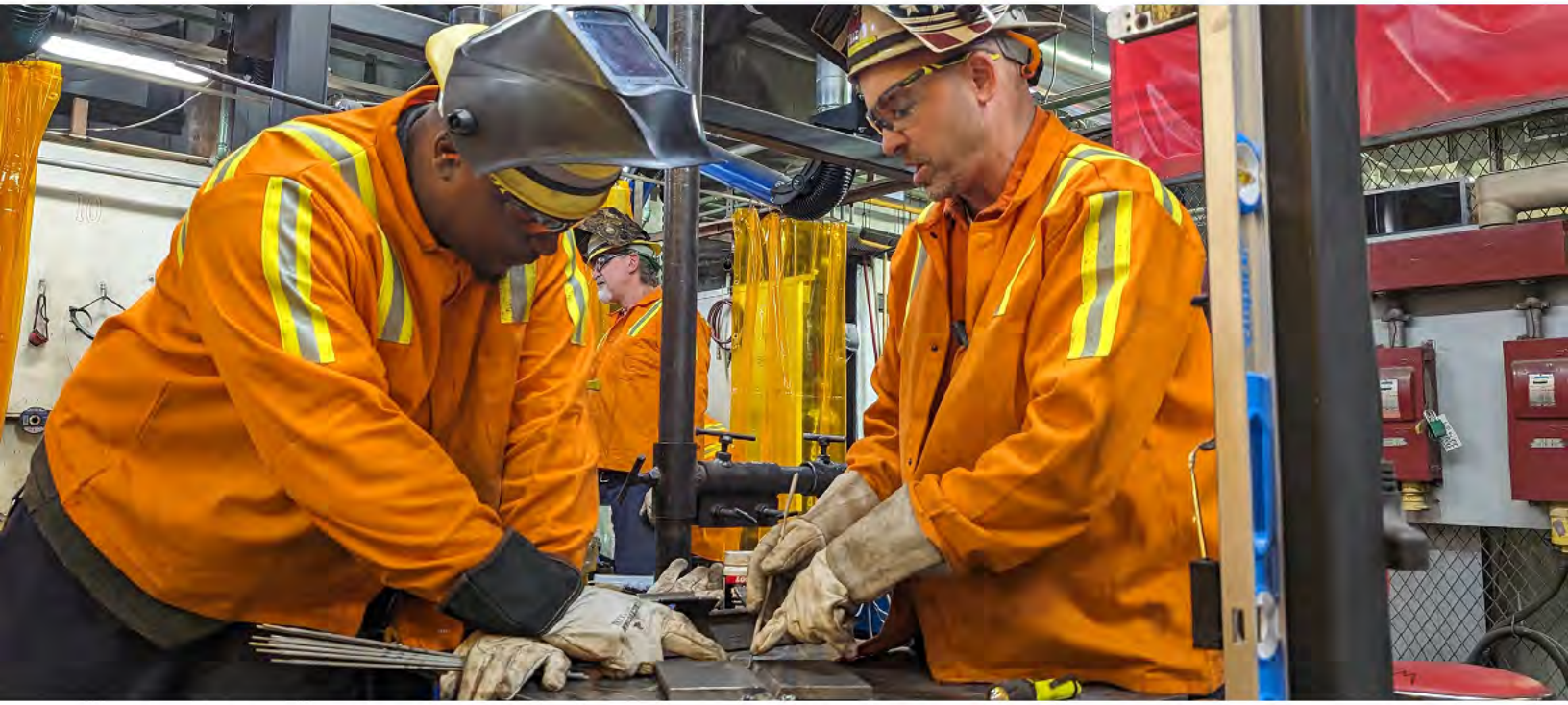
EXHIBIT 12

U.S. DOE's Office of Clean Energy Demonstrations, Steel Slab Electrified Induction Reheat Furnace Upgrade

STEEL SLAB ELECTRIFIED INDUCTION REHEAT FURNACE UPGRADE

Community Benefits Commitments Summary



Two Cleveland-Cliffs welders examine task at hand

This Community Benefits Commitments fact sheet describes how OCED's Industrial Demonstrations Program's Steel Slab Electrified Induction Reheat Furnace Upgrade project award recipient, Cleveland-Cliffs Steel Corporation (Cleveland-Cliffs), plans to engage community and labor stakeholders during Phase 1 and develop plans for workforce development, quality jobs, maximizing project benefits, and minimizing or mitigating any potential negative impacts. These commitments will be updated at the end of each phase to reflect key learnings and developments as the project advances.

The Steel Slab Electrified Induction Reheat Furnace Upgrade project at the Cleveland-Cliffs Butler Works Steel Mill plans to electrify the only production facility for high-silicon grain oriented electrical steel (GOES) in the United States. GOES is a critical input used in the manufacturing of electric transformers. By implementing induction heating—a highly energy efficient heating method that minimizes energy losses and enables precise control over temperatures—this project aims to secure a crucial component of the U.S. domestic energy supply chain and could be widely replicable among the many iron and steel facilities that use reheat furnaces across the nation. Cleveland-Cliffs estimates the furnace installations could result in up to a 100% reduction in direct greenhouse gas emissions associated with the high-temperature reheat furnaces and improve air quality for the nearby communities.

TABLE OF CONTENTS

COMMUNITY AND LABOR ENGAGEMENT ACTIVITIES

Cleveland-Cliffs is committed to incorporating community input, support, and concerns into decision making to promote accountability and equitable distribution of benefits. During Phase 1, this includes gathering input on community interests, concerns and priorities for the project, job training, and local hiring.

Cleveland-Cliffs is committed to:

- Soliciting input on local priorities for community benefits activities
- Hosting one or more public open houses to engage stakeholders and community members
- Meeting with unions to evaluate additional apprenticeship opportunities
- Utilizing the established Community Inquiry Program to enable stakeholder dialogue with Cleveland-Cliffs
- Pursuing formal partnerships with Butler County Chamber of Commerce, Butler County Center for Disease Control, Butler County Community College to continue their apprenticeship program with Cleveland-Cliffs, and Butler County Board of Commissioners to build on local government involvement

WORKFORCE AND COMMUNITY AGREEMENTS

In an effort to support good jobs and community commitments, Cleveland-Cliffs is committed to the following actions associated with workforce and community agreements during Phase 1:

- Utilizing an existing Collective Bargaining Agreement with the United Auto Workers Local 3303, which covers hourly workers for this project at the Butler Works facility
- Engaging with local Building Trades Unions to support installation of the induction reheat furnaces
- Initiating discussions with stakeholders regarding a Community Benefits Agreement or alternative community investment plan

QUALITY JOBS AND WORKFORCE DEVELOPMENT

This project would sustain more than 1,000 existing union jobs at the Butler Works facility, support 160 union jobs at the Zanesville Works facility in Ohio, support more than 200 Building Trades Unions construction jobs, and provide training opportunities for the operation and maintenance of the new technology as well as other skills needed at Butler Works. During Phase 1, Cleveland-Cliffs plans to develop a detailed training and staffing plan that includes:

- Goals for quality workforce development for both operations and construction, and in accordance with existing labor agreements as applicable, including:
  - Share of hours worked filled by apprentices in state-certified apprenticeship programs
  - On-the-job training/workforce development hours
  - Funding for workforce development (e.g., preapprenticeship programs, paid internships, wrap-around services, etc.)
  - Recruitment, training, hiring, and retention goals for local residents, dislocated workers/workers from energy or industrial facilities, or workers from underrepresented or disadvantaged communities
- Documentation of impacts on the existing workforce and strategies to mitigate negative effects, with plans to engage hourly workers and unions in the design and implementation of workplace health and safety plans
- Engaging United Auto Workers (UAW) Local 3303 and the local Building Trades Unions in the development of training plans/apprenticeships necessary to meet the skills requirements for the project

EQUITABLE IMPACTS

Cleveland-Cliffs plans to improve business opportunities for Underrepresented groups and ensure benefits flow to local and Disadvantaged communities. During Phase 1, Cleveland-Cliffs plans to:

- Identify potential diversity, equity, inclusion, and accessibility (DEIA) goals for Cleveland-Cliffs' apprenticeship program, including by working with UAW Local 3303, local Building Trades Unions, and Butler Community College
- Incorporate DEIA objectives into supplier outreach process, including by conducting a baseline assessment of existing practices
- Provide an updated Justice40 assessment prior to end of the phase, including documentation of engagement from community stakeholders and broader community input
- Develop a Justice40 implementation strategy by end of Phase 1, which seeks to maximize project benefits (including, but not limited to, reduced air emissions from the facility and increased use of suppliers from underrepresented businesses) to local and disadvantaged communities while proactively eliminating, minimizing, mitigating, and monitoring any potential negative impacts

PUBLIC DATA REPORTING

Cleveland-Cliffs will share project information publicly to support engagement, accountability, and transparency. The project plans to keep community members apprised of project development through a dedicated project website to communicate project information and stakeholder engagement opportunities including:

- Engagement opportunities
- Project anticipated timelines and status updates
- Contact information for project team
- Progress towards community benefits commitments
- Anticipated project impacts
- Emergency response plans and safety protocols, if consistent with relevant regulatory requirements
- Environmental data (including air quality and emissions baseline monitoring)
- Monitoring and mitigation plans

EXHIBIT 13

Cleveland-Cliffs, U.S. Energy Dept.: Butler Works Project

CLIFFS

U.S. Energy Dept.: Butler Works Project

SUSTAINABILITY

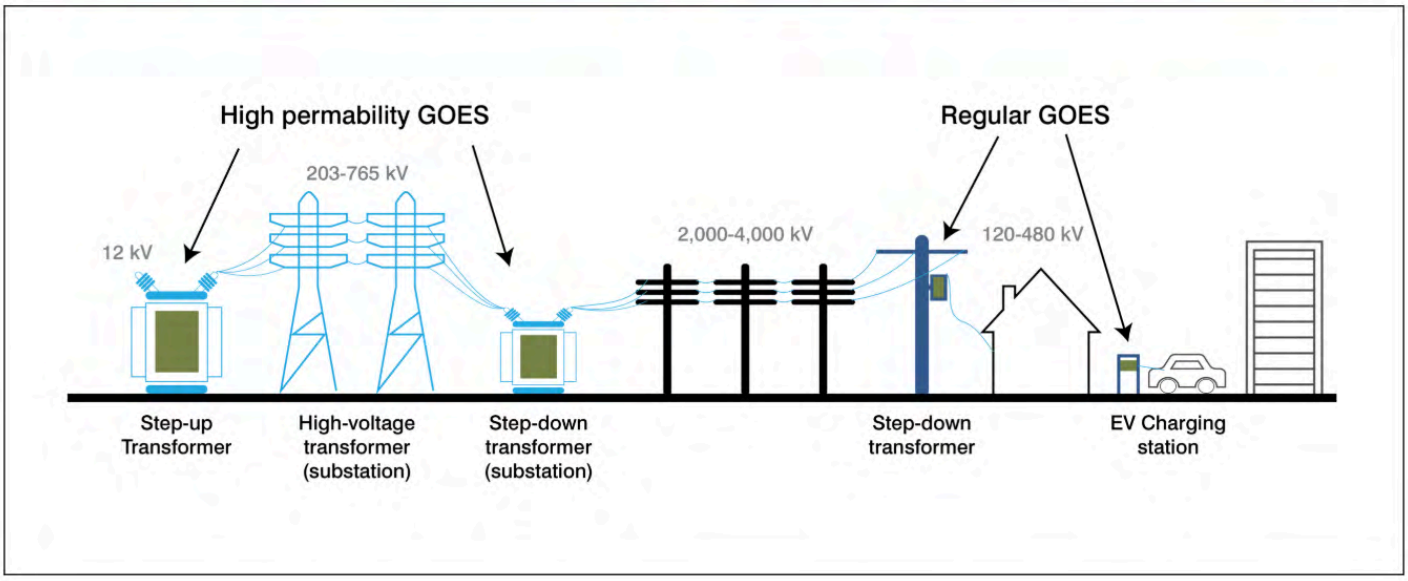
STEEL AS A SUSTAINABLE MATERIAL

U.S. DEPARTMENT OF ENERGY AWARDEE™

Cleveland-Cliffs is leading the way in decarbonization. Learn more about the Steel Slab Electrified Induction Reheat Furnace Upgrade at Cleveland-Cliffs Butler Works in Lyndora,

PA.

Steel Slab Electrified Induction Reheat Furnace Upgrade



The Steel Slab Electrified Induction Reheat Furnace Upgrade project plans to electrify certain processes at Cleveland-Cliffs Butler Works, the leading production facility for high-silicon grain oriented electrical steel (GOES) in the United States. GOES is a critical input for transformers and the electricity sector. The project will construct four new

induction reheat furnaces that will replace two existing natural gas fired slab reheat furnaces.

Project Quick Facts

- Total Federal Cost Share: Up to $75 million
- Expected Completion in 2029

Phase 1

Planning, permitting, design, and other development activities

- Start Date: August 2024
- Timeline: 8 months
- Phase 1 Total Project Amount: $38,151,901
- Phase 1 OCED Award Amount: $19,074,900

Industrial Demonstrations Program

This project is being conducted with the support of the U.S. Department of Energy (DOE) Office of Clean Energy Demonstrations (OCED). Through the Industrial Demonstrations

Program, DOE aims to accelerate decarbonization projects in energy-intensive industries and provide American manufacturers a competitive advantage. The Industrial Demonstrations Program includes new, emerging technologies that aim to help produce clean steel, cement, chemicals, and other materials used in our nation's roads, bridges, transmission lines, electric vehicles, solar panels, wind turbines, and everyday lives, which in turn, benefit every American.

EXHIBIT 14

Inductotherm Group, Slab Heating and Reheating Systems

INDUCTOTHERM GROUP

INDUCTOTHERM

SLAB HEATING AND REHEATING SYSTEMS

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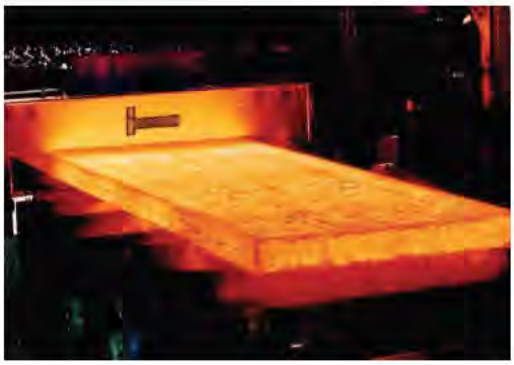

PRODUCT DETAILS

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EXHIBIT 15

Kintek Furnace, Which Industries Commonly Use Induction Melting Technology? Unlock Precision and Efficiency in Metal Processing

Tech Team · Kintek Furnace
Updated 2 months ago

Which Industries Commonly Use Induction Melting Technology? Unlock Precision And Efficiency In Metal Processing

At its core, induction melting technology is the preferred method across any industry that requires clean, controlled, and efficient melting of metals. Its primary users include foundries, metal casting facilities, and the automotive, aerospace, and recycling sectors. Advanced fields like medical device manufacturing, electronics, and green energy also rely heavily on its precision.

> Induction melting's value is not just in its ability to heat metal, but in its capacity for **unmatched precision, speed, and purity**. This control is why it has become an indispensable tool for industries ranging from high-volume manufacturing to high-purity advanced materials.

The Core Appeal of Induction Melting

Induction melting is an advanced process that uses electromagnetic induction to heat and melt conductive materials, primarily metals. Unlike traditional furnaces that use external heat sources, induction heating generates heat directly within the material itself.

Unmatched Speed and Efficiency

The direct heating method is exceptionally fast, significantly reducing melt times compared to conventional fuel-fired furnaces. This speed, combined with high energy efficiency, translates directly to lower operational costs and higher throughput.

Superior Purity and Control

Because there is no contact between the heating source and the metal, the risk of contamination is virtually eliminated. This makes induction melting ideal for producing high-purity alloys. Furthermore, the process offers extremely precise temperature control, ensuring consistent metallurgical quality batch after batch.

Key Industrial Applications

The unique benefits of induction melting make it a cornerstone technology in several critical industries, each leveraging its specific advantages.

Foundries and Metal Casting

This is the most traditional and widespread application. Foundries use induction furnaces to melt a vast range of metals, including **iron, steel, aluminum, and copper**, for casting into parts. Its ability to handle large volumes consistently and recycle scrap metal efficiently makes it the industry standard.

Automotive and Aerospace Manufacturing

Both industries demand high-performance components with zero tolerance for defects. Induction melting is used to produce critical parts like **engine blocks, transmission components, and turbine blades**. The process ensures the metallurgical integrity and strength required for these high-stress applications.

Precious Metals and High-Value Alloys

In jewelry making and precious metal refining, minimizing material loss is paramount. Induction melting provides the **tight control over small, high-value batches** of gold, silver, and platinum needed to prevent waste and ensure purity. It is also critical for producing the specialized superalloys used in aerospace and defense.

Advanced and Green Technologies

Modern industries rely on induction melting for cutting-edge materials. It is used to produce the high-purity silicon for **solar panels** and the specialized metals required for **semiconductors and electronic components**. It is also essential for producing fine metal powders for **3D printing** (additive manufacturing) through processes like gas atomization.

Medical Device Manufacturing

The medical field requires materials that are both biocompatible and exceptionally strong. Induction melting, often performed in a vacuum, is used to create the high-purity titanium and stainless steel alloys for **surgical instruments and medical implants** like hip and knee replacements.

Understanding the Trade-offs

While powerful, induction melting is not a universal solution. The primary considerations are its specialization and initial investment.

High Capital Cost

The equipment for induction melting represents a significant upfront capital investment compared to some simpler, fuel-fired furnace technologies. The decision to adopt it must be justified by the need for high quality, efficiency, or throughput.

Material Limitations

The technology works by inducing an electrical current within the material itself. Therefore, it is highly effective for **conductive metals** but is not suitable for melting non-conductive materials like ceramics or glass.

Process Complexity

Operating an induction furnace system requires skilled technicians and robust process controls. While it offers precision, achieving that precision demands a higher level of operational expertise than a basic furnace.

Making the Right Choice for Your Goal

The decision to use induction melting hinges on your primary objective.

If your primary focus is high-volume production and efficiency: This technology is ideal for foundries, automotive suppliers, and recyclers who need to melt large quantities of standard metals quickly and cost-effectively.

If your primary focus is material purity and performance: This is the non-negotiable choice for aerospace, medical, and electronics manufacturing where material contamination could lead to catastrophic failure.

If your primary focus is control over valuable or exotic materials: This method provides the precision required for handling precious metals, creating specialized alloys for research, or producing metal powders for advanced manufacturing.

Ultimately, induction melting empowers industries by providing precise and repeatable control over the fundamental process of transforming solid metal into a liquid state.

Summary Table:

INDUSTRY	KEY APPLICATIONS	CORE BENEFITS
Foundries & Metal Casting	Melting iron, steel, aluminum, copper for parts	High volume efficiency, scrap recycling
Automotive & Aerospace	Engine blocks, turbine blades, transmission components	High purity, strength, defect-free production
Precious Metals & Alloys	Jewelry, gold, silver, platinum refining	Precise control, minimal waste, high purity
Advanced & Green Tech	Solar panels, semiconductors, 3D printing powders	Material purity, specialized alloy production
Medical Device Manufacturing	Surgical instruments, implants (e.g., titanium alloys)	Biocompatibility, high strength, contamination-free

Ready to enhance your metal melting processes with precision and efficiency?
Leveraging exceptional R&D and in-house manufacturing, KINTEK provides diverse laboratories with advanced high-temperature furnace solutions. Our product line, including Muffle, Tube, Rotary Furnaces, Vacuum & Atmosphere Furnaces, and CVD/PECVD Systems, is complemented by our strong deep customization capability to precisely meet unique experimental requirements. Whether you're in automotive, aerospace, medical, or other sectors, we can help you achieve superior results. Contact us today to discuss how our tailored solutions can benefit your operations!

Visual Guide

Which Industries Commonly Use Induction Melting Technology?

The preferred method for clean, controlled, and efficient metal melting across diverse sectors.

FOUNDRIES & METAL CASTING

Applications: Iron, Steel, Aluminum, Copper parts.
Benefits: High Volume Efficiency, Scrap Recycling.

AUTOMOTIVE & AEROSPACE MANUFACTURING

Applications: Engine blocks, Turbine blades, Transmission components.
Benefits: High Purity, Strength, Defect-Free Production.

PRECIOUS METALS & HIGH-VALUE ALLOYS

Applications: Jewelry, Gold, Silver, Platinum refining.
Benefits: Precise Control, Minimal Waste, High Purity.

ADVANCED & GREEN TECHNOLOGIES

Applications: Solar Silicon, Semiconductors, 3D Printing Powders.
Benefits: Material Purity, Specialized Alloy Production.

MEDICAL DEVICE MANUFACTURING

Applications: Surgical Instruments, Implants (Titanium Alloys).
Benefits: Biocompatibility, High Strength, Contamination-Free.

TRADE-OFFS & CONSIDERATIONS

PROS & APPEAL | CONS & CHALLENGES

Unmatched Speed & Efficiency (Lower operational costs, higher throughput)
Superior Purity & Control (No contact, consistent quality).

High Capital Cost (Significant upfront investment)
Material Limitations (Conductive metals only; no ceramics/glass)
Process Complexity (Requires skilled operation).

Related Products

Vacuum Induction Melting Furnace

600T Vacuum Induction Hot Press Vacuum Heat Treat and Sintering Furnace

1700°C High Temperature Laboratory Tube Furnace with Alumina Tube

Laboratory Muffle Oven Furnace with Bottom Lifting

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EXHIBIT 16

Inductotherm Group, Induction heating for the steel industry


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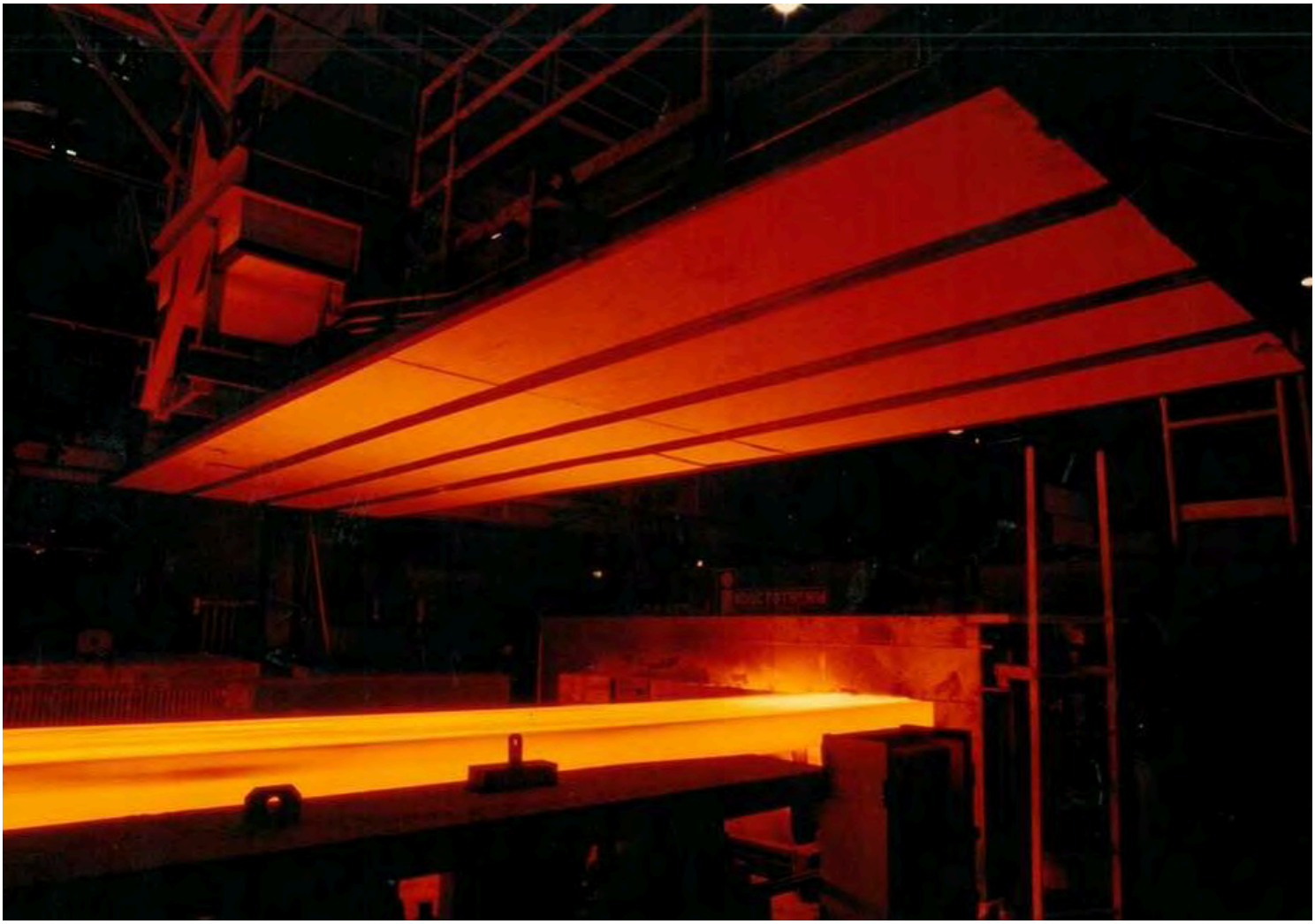
INDUCTION HEATING FOR THE STEEL INDUSTRY



INDUCTION TECHNOLOGIES OFFER A CLEANER SOLUTION TO YOUR HEATING NEEDS WHEN COMPARED TO ALTERNATE HEATING METHODS – LIKE COMBUSTION FURNACES WHICH MANY ROLLING MILLS USE TODAY. ADDITIONALLY, INDUCTION SYSTEMS OFFER A BETTER RETURN ON YOUR INVESTMENT, LOWER OPERATING COSTS, HIGHER QUALITY END

PRODUCTS AND REDUCED METAL LOSSES AND TOXIC EMISSIONS. THESE SYSTEMS ARE ALREADY BEGINNING TO CHANGE THE LANDSCAPE OF THE STEEL INDUSTRY AND ARE A GREAT PART OF THE SOLUTION TO DECARBONIZING THE STEEL ROLLING PROCESS.

Providing the rolling mill with a continuous supply of uniformly heated steel slabs, billets, bars and blooms at the proper temperature is crucial to efficient mill operations. Our induction heating systems for bars, blooms, billets, plate, strip and slabs are used prior to rolling operations. Temperature control and consistency are maintained from the surface to the core and over the length of the product.

Induction heaters can be used alone or in conjunction with combustion furnaces on green field projects or brown field projects.

BASIC BENEFITS OF INDUCTION HEATERS FOR ROLLING MILLS:

- Higher production flexibility.
- Higher quality products.
- Lower operating costs.
- Reduced carbon emissions.
- Reduced metal losses.

INDUCTION HEATERS CAN ALSO HELP YOU DECARBONIZE BY REDUCING CO_2, SO_2, NO_X AND OTHER TOXIC EMISSIONS BY AT LEAST 50%.

In a combustion furnace, heat is created by burning a fuel such as coke, oil or natural gas. The burning fuel heats up the inside of the furnace. This then heats up the surface of the product inside the furnace. The time required to heat the workpiece is determined by the thermal conductivity of the material.

Induction furnaces heat without burning fuel. Heat is generated on the surface of the product itself by the flow of an electrical current.

That doesn't mean you have to completely replace your combustion furnaces. In fact, when induction heaters are used in conjunction with traditional combustion furnaces, your mill can reduce toxic emissions by 50% or more as well as increase production, improve quality, decrease operating costs and extend the life of your combustion furnaces.

A smart steel mill will look at both options to determine the optimal solution for their process.

ADDITIONAL BENEFITS OF INDUCTION HEATERS FOR ROLLING MILLS:

- Temperature homogeneity for continuously cast products.
- Modular design to meet any layout requirement.
- Level control to centralize all bar sizes in coil opening.
- High-efficiency, state-of-the-art power supplies in a range of frequencies covering all heating applications.
- Close-coupled, high-efficiency independently controlled induction heating stations.
- Fully automated level 1 and level 2 controls.

INDUCTOTHERM'S IMZ® RE-HEATER TECHNOLOGY

The best opportunity for mills is to replace or integrate existing combustion furnaces with new induction systems like Inductotherm's IMZ® re heater technology.

Inductotherm's IMZ® multi-zone technology takes induction furnaces to the next level. With several coil zones, each individual heating zone can be controlled to provide any desired temperature profile along the workpiece to meet the specific requirements of the rolling mill.

Utilizing induction technology from Inductotherm can deliver immediate benefits to rolling mills by significantly boosting their annual production of quality rolled products at a lower operating cost and with lower emissions.

For green field projects, the mill builder has multiple options in the configuration of the equipment layout. Induction furnaces can be placed in-between the Continuous Casting Machine(CCM) and the Rolling Mill(RM), upstream the rolling mill or in-between rolling stands.

For brown field projects there are several solutions available using the IMZ® modular design. For example, the IMZ® induction re heater can be placed between the CCM and the RM or in between rolling stands when induction reheating is required by the rolling process. Another option for existing “brown field” RMs is to install an IMZ™ induction heater upstream of the combustion furnace to partially heat cold stock prior to homogenizing to the rolling temperature in the combustion furnace.

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EXHIBIT 17

Moravec, Rudolf. Association for Iron and Steel Technology, 2017 Japan Caster Tour Recap

2017

Ron O'Malley (left) presented a plaque of appreciation to Jun Eguchi (center), manager, steelmaking section, Chita Plant, and Masayuki Shiratori (right), associate senior engineer, steelmaking section, Chita Plant, Daido Steel Co. Ltd. for hosting the tour group.

AIST Japan Caster Tour Recap

By Rudolf Moravec

The Association for Iron & Steel Technology (AIST) and The Iron and Steel Institute of Japan (ISIJ), with their affiliated technology committees for continuous casting, worked together to prepare a study tour in Japan for the end of 2017. The tour included an interesting mix of flat and long product steel producers and a variety of plants using steel produced with the electric arc furnace (EAF) as well as the basic oxygen furnace (BOF) manufacturing processes.

Fig. 1 — Travel map of the visited plant locations.

U.S.–based steel manufacturing companies have a long and interesting history of cooperation with Japanese steel industry firms. Some of them even today have joint-venture projects in the U.S. On the other hand, very little is published about the status of continuous casting technology in Japan, and therefore knowledge about trends in this area of steel production are not well known. All of these factors triggered a huge interest in this tour among U.S. producers. The final itinerary included three long product producers (Sanyo Special Steel, Daido Steel Co. Ltd. and Aichi Steel) and four flat product producers (Kobe Steel, JFE Steel, Nisshin Steel and Nippon Steel & Sumitomo Metal Corp.). Fig. 1 shows the locations of the plants visited.

A maximum of 23 attendees were approved by ISIJ, with only producers being allowed to participate. Among the participating companies, seven attendees were ArcelorMittal representatives, three from United States Steel Corporation, two from TimkenSteel Corp., two from Steel Dynamics Inc., two from Nucor Corp., two from Ternium Brasil and one from Stelco. In addition, there were two representatives from TMEIC, the organizer of the trip; one AIST staff member; and one representative from Missouri University of Science and Technology. The tour group was accompanied by a representative from the ISIJ.

On Monday, 6 November 2017, the first stop of the tour was Kobe Steel – Kakogawa Works. The plant is located around 50 miles east of Osaka on the east coast of Japan. Kakogawa Works is currently undergoing a modernization phase as well as increasing capacity. Kobe Steel decided to shut down primary operation sites at Kobe Works due to asset optimization in 2017. Among the US$600 million capital expenditure for this project was a new bloom caster. In 2016, Kakogawa Works produced 7 million metric tons of crude steel; 2.7 million metric tons were long products. The site currently employs 2,700 employees. Its product range includes plate, hot- and cold-rolled strip/sheets for automotive, construction and household appliances. The fully integrated mill includes three blast furnaces that supply hot metal to the pre-treatment plant. Desulfurization of hot metal is done at a Kanbara reactor (KR) station and dephosphorization of hot metal in a separate process to prepare hot metal for further steelmaking processing. Pre-treated hot metal is charged into one of three BOF vessels. Secondary metallurgy includes various treatment stations: two ladle furnaces, two composition adjustment by sealed argon (CAS) stations and four Rurhstahl Heraeus (RH) degassers. Steelmaking operations include five continuous casting machines, all of which were being used during the visit. A brand-new bloom caster, 6CC (start-up in early 2017), was the highlight of the tour. This 5-strand caster was designed and built by Kobe. The produced bloom has a size of 300 x 430 mm. The caster has a 63-metric-ton tundish and it is equipped with a stopper rod for start-up operation and a slidegate system for regular casting operation. The caster has a straight 1-m-long mold instrumented with thermocouples for breakout protection. The machine is fully segmented (33.4 m) to achieve superior surface and internal bloom quality. The annual capacity of this caster is 1.7 million metric tons. The steelmaking facility operates another bloom caster

(2CC), which started up in 1980 and has a bloom size of 380 x 630 mm. The slab casting building is in close proximity to the BOF shop and includes three continuous slab casting machines. The 2-strand slab caster (3CC) and 1-strand slab caster (4CC-1STR) are vertical bending–type and are mainly dedicated to strip production. The 4CC-2STR is also a vertical bending–type caster with one strand where slabs for plate mill production are being cast.

The next stop on the first day was long product producer Sanyo Special Steel. The production site was located just 20 miles south from Kobe Steel – Kakogawa Works. Sanyo Special Steel produces steel at two steelmaking facilities. The products range from bearing steel and tool steel to engineering steel. The steelmaking facility visited has a 150-ton EAF, ladle furnace, RH degasser and a 3-strand vertical bloom caster. Total yearly production is around 1 million metric tons. The continuously cast blooms are 380 x 530 mm in size with an average casting speed of 0.5 m/minute. One of the unique characteristics of this caster is that it uses a specially designed tundish (Sanyo New Refining Process or SNRP) with two separate chambers for better inclusion removal. The caster holds a record for casting 100 heats on one submerged-entry nozzle (SEN).

On Tuesday, 7 November 2017, the delegates visited JFE Steel – Kurashiki Works. This plant is part of JFE Steel Corp. West Japan Works, which has a total production capacity of 19.5 million metric tons. JFE was created in 2002 through the merger of NKK and Kawasaki Steel. Product portfolio of JFE Kurashiki Works includes electrical steel, plate, hot- and cold-rolled sheets, and seamless pipes. Two steelmaking plants are fed from two blast furnaces with a total capacity of 27,000 metric tons per day of hot metal. The tour group visited the No. 2 Steelmaking shop, where total steel production is around 6 million metric tons. All hot metal is processed through a pre-treatment center where silicon and phosphorus are removed directly in torpedo cars. The steelmaking shop is equipped with a KR station for hot metal sulfur removal, three K-BOP vessels, two twin RH (Kawasaki top blowing or KTB) degassers, ladle furnace and two 2-strand slab casters. The ladle size is 345 metric tons. The No. 6 CCM is a fully vertical caster for plate production, with nine segments. It has a 16-m metallurgical length and 1 m/minute average casting speed. It was impressive to observe the bending of the slab directly from a nearby observation deck. Slab thicknesses that can be cast are 215, 260 and 310 mm. The next caster visited was the No. 4 CCM. This is a vertical bending machine with a 3-m-long straight section. The caster is capable of casting up to 3 m/minute. Its metallurgical length is 45 m, with eight segments in the bow and 11 segments in the horizontal section. The tundish size is an impressive 80 metric tons. A hot tundish recycling

Ron O'Malley (left) presented a plaque of appreciation to Jin Yoshida (right), manager, steelmaking technology section, Kobe Steel Kakogawa Works.

Ron O'Malley (left) presented a plaque of appreciation to Kazuya Mishima (center), general manager, steelmaking department, Sanyo Special Steel.

technique is used for this caster. This technique allows the refractory lining to be used for up to 500 heats without any spray material.

After the tour at JFE Steel, the longest bus ride on the tour was to Hiroshima. The trip took around 3 hours. The schedule for the next day was a tour of Nisshin Steel – Kure Works. Kure Works is located 20 miles south of Hiroshima. The group utilized this opportunity and visited the Hiroshima Peace Memorial Museum and Atomic Bomb Dome site to pay their respects and remember the past.

Nisshin Steel – Kure Works has a very interesting location compared to the previously visited plants. It is located at the end of the bay area at Kure City, next to a shipbuilding yard. Nisshin Steel became part of Nippon Steel & Sumitomo Metal Corp. in early 2017. Kure Works operates two steelmaking facilities where each has one slab caster. Both casters were visited during the tour. Steel production capability for Kure Works is 3.5 million metric tons per year. Hot metal is produced in two blast furnaces with total hot metal production of 10,000 metric tons per day. The No. 1 Steelmaking shop has two 90-metric-ton BOF vessels and a ladle furnace. The 2-strand caster is a fully vertical type and it is dedicated to production of high-alloyed and stainless steel grades. It has a metallurgical length of 12.8 m with a slab thickness of 200 mm. After a quick visit at this vertical caster, the group moved to the No. 2 Steelmaking shop. A 185-metric-ton BOF vessel and RH degasser are producing steel for a 2-strand vertical bending–type caster. Total steel output for this shop is 2.7 million metric tons per year. The vertical section of this machine is 3.5 m. The majority of slabs produced at this caster are hot charged into the nearby hot mill.

Ron O'Malley (right) presented a plaque of appreciation to Takashi Yamauchi (center), manager Kurashiki steelmaking technology section, and Yusuke Watanabe (left), staff assistant manager, JFE Steel.

Ron O'Malley (center) presented a plaque of appreciation to Hideki Tanaka (left), general manager, steelmaking department, Nisshin Steel – Kure Works, and Masahiro Isobe (right), leader, technology team, steelmaking department, Nisshin Steel – Kure Works.

The next stop was in the northern part of Kyushu island where we were scheduled to visit Nippon Steel & Sumitomo Metal Corp. – Yawata Works. Yawata Works consists of three different plants — Yawata, Tobata and Kokura. Only the Tobata plant was visited. This plant includes No. 1 and No. 3 Steelmaking shops. Only the No. 3 shop was visited during the tour. The visit started unexpectedly at the cast floor of the blast furnace and caught everybody by surprise. However, this stop showed everybody how the company is serious about environment, safety and housekeeping issues. Even standing a couple yards from the tapping side of the blast furnace, no smoke, dust or flying graphite was visible, which was very impressive.

Ron O'Malley (right) presented a plaque of appreciation to Shinsuke Ikegami (center), general manager, vice head of works, Yawata Works, and Masato Kobayashi (left), general manager, head of Tobata Steelmaking Technical Department, Steelmaking Division, Nippon Steel & Sumitomo Metal Corp.

No. 3 Steelmaking shop is equipped with a hot metal mixer with a 2,000-metric-ton capacity and induction heating capability, desulfurization stations – KR and injection, two Linz Donawitz-optimized refining process (LD-OPR) vessels, two revolutionary degassing activator (REDA) degassers, and four CAS-OB stations where the heat size is 350 metric tons. The shop has four 1-strand casters. The No. 1 strand is a curved machine mainly dedicated to stainless steel, which is produced at the No. 1 Steelmaking shop. The 30-metric-ton delta-shape tundish is equipped with plasma heaters. The No. 2 and 3 strands are vertical bending machines with 2.5-m

Jumpei Konishi (right), general manager head of steelmaking technology division, Nippon Steel & Sumitomo Metal Corp., presented Ron O'Malley (right), second vice president of AIST and Continuous Casting Technology Committee study tour chair, with a plaque of appreciation.

straight sections. The No. 4 strand is a combo caster with a curved mold. Five different bloom sizes can be cast. No. 3 and No. 4 strands used the same type of tundish design, which is equipped with induction heating. One of the highlights was the superior cleanliness of steel production, where no tundish flux is used. The tundish is sealed and argon purged during casting.

After the tour, a lunch was organized to offer an opportunity for further discussion and a chance to listen to a little bit of the history of Yawata Works. Some of the parts are on the list of UNESCO World Heritage Sites.

A highly anticipated train travel followed immediately after the lunch. The group traveled from Kokura to Nagoya, the last stop of the tour, by high-speed bullet train. The journey of 500 miles took 3 hours with a maximum train speed of 180 miles per hour.

Before the last day of the tour, the delegates had an opportunity to meet with ISIJ Casting Committee members, who represented the companies visited during the tour. This banquet started with the ISIJ Casting Committee chair addressing past cooperation experiences and future possibilities. On behalf of the AIST Caster Study Tour participants, Ron O'Malley, AIST Continuous Casting Technology Committee study tour chair, thanked everybody for their effort to accommodate this group and invited them to visit the United States for a similar tour.

Two visits were scheduled on the last day of the tour. Daido Steel – Chita plant was the first stop. The production focuses on alloyed steel, free-cutting steel, bearing steel, spring steel and stainless steel. Total production of the plant is 140,000 metric tons/month. The steelmaking facility includes four 80-metric-ton EAFs and one 150-metric-ton EAF, three ladle metallurgy furnaces, three RH degassers, and an argon oxygen decarburization (AOD) converter. Casting capabilities included two bloom casters, promising hybrid caster (PHC) jumbo caster and ingot casting. The tour route included a visit to the EAF viewing room, where the 150-metric-ton EAF operations could be observed via a large window and all technical details about the plant could be seen. This EAF has a unique way to accelerate scrap melting without increasing energy cost. The principle is to rotate the EAF shell by 50° after the second scrap bucket is charged. The distance to the unmelted scrap from the electrodes is changed to a closer proximity and therefore final melting is faster. With this improvement, the energy power consumption was reduced by 5%. The next stop during the Daido tour was CC1, a 2-strand bloom caster with a bloom size of 370 x 510 mm. The caster is equipped with all three types of electromagnetic stirrers along the strand — MEMS, SEMS and FEMS. The bloom surface temperature is monitored with pyrometers, and if an anomaly occurs, hot scarfing is available to improve surface quality. CC2 was the last stop of this tour. CC2 is a fully vertical caster with four strands and with only one format to cast — a 350-mm round bloom. This caster is equipped with dynamic soft reduction, a plasma heater in the tundish, and mold and strand stirrers. One more thing that should be mentioned, even though it was not visited, was the PHC caster, which allows batch casting (two strands) of 650 x 850 mm blooms.

The last stop of the study tour was Aichi Steel, which is in proximity of Daido Steel. This plant was originally a Toyota plant for supplying the automaker with necessary steel parts. In the product portfolio, one can find all automotive components that can be made from steel. Two steelmaking shops are being utilized for production. The No. 2 shop was visited, where a 150-metric-ton EAF, ladle furnace and RH degasser are installed. The continuous caster visited is a 3-strand bloom caster with a casting size of 480 x 370 mm. The caster is equipped with a tundish plasma heater, dynamic soft reduction and hard reduction, which is applied to the fully solidified bloom. Unfortunately, there was a caster maintenance outage during the visit.

Aichi Steel was the final stop on the study tour.

Study tours are not only a great opportunity to visit manufacturing plants and learn different approaches to producing steel, but also to allow participants to interact among themselves. Another unique thing is experiencing different cultures. Traveling to the south of Japan gave the delegates an opportunity to visit some historical and cultural sites. While staying in Osaka, the group had a chance to visit two historical places in proximity of Kyoto, Nijo-jo Castle and Fishimi Inaru-taisha.

Very clear examples of how to approach environmental and safety topics were seen in each of the plants visited. Furthermore, a clear bond with the community was highlighted during each introductory presentation. If something was a little bit surprising, it was the minimal amount of automatization observed and lack of modernization viewed in the control rooms, where it appeared that time stopped several years ago compared to U.S. plants.

The study tour delegates thank their dinner sponsors, NALCO, SteelPlantech, ArcelorMittal, United States Steel Corporation, Steel Dynamics Inc. and TMEIC, for providing a dinner. This dinner not only increased participants' knowledge, but tickled their taste buds with real Japanese food.

Finally, the delegates are appreciative to TMEIC for the logistic planning. They did an excellent job with all the arrangements, not only for transportation and lodging but also with sightseeing stops to get a little bit of Japanese culture and history. Thank you Ippei, Kazuto and Thomas!

In remembrance of tour comrade, colleague and friend Chris Kennedy, 60, who passed away on 5 January 2018. ✦

AIST Caster Study Tour group enjoyed a dinner sponsored by TMEIC: Pat Philbin (right), AIST, with Ippei Shibata (left), TMEIC.