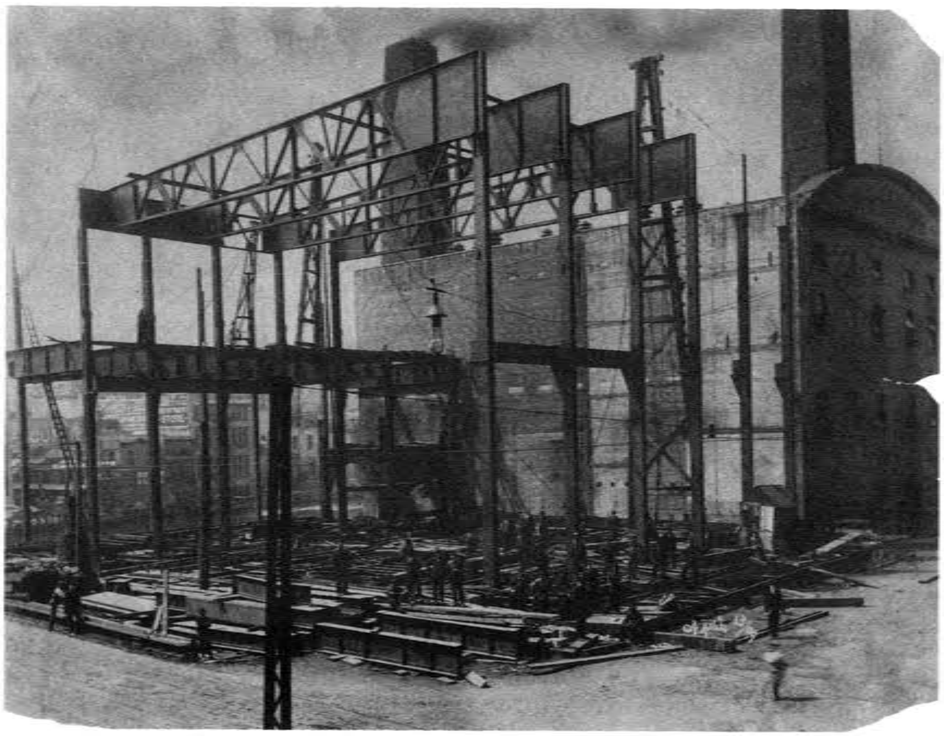
East Wells Power Plant: A National Historic Mechanical Engineering Landmark

From River Street to East Wells–90 years of service



One of Wisconsin's oldest power plants, East Wells actually has been the home of several plants.

The first was the Edison Electric Illuminating Co., better known as the River Street Plant, built in 1890 on River Street along the Milwaukee River. Established by the Edison General Electric Co. of New York, the River Street Plant was sold to the North American Co. later that year and transferred to the holding company's Milwaukee Street Railway Co. in 1891. The plant later became known as the Edison Street Plant, when River St.'s name was changed to Edison St.

The Oneida Street Plant was built next door to the Edison Street Plant in 1900 by The Milwaukee Electric Railway and Light Co. (TMER&L), also controlled by North American. TMER&L is the direct predecessor of Wisconsin Electric. When Oneida St. was built, the Edison Street Plant became part of it. And one more name change was to come when Oneida St. was renamed East Wells St., and the plant's name also was changed.

Today East Wells burns both coal and oil. It is capable of producing 12,000 kilowatts of electricity for the Wisconsin Electric System, or 440,000 pounds of steam for process use, hot water and space heating for downtown Milwaukee.

It is called into action to produce steam during periods of extreme cold weather or electricity when certain other generating units in the WE System are out of service.

We are proud of honor; proud that innovation is not a thing of our past

Charles S. McNeer
President/Chief Executive Officer
Wisconsin Electric Power Company

Wisconsin Electric is proud of the American Society of Mechanical Engineers' designation of our East Wells (Oneida Street) Power Plant as a national historic mechanical engineering landmark.

This honor underscores our long history of striving to meet our responsibility for providing reliable electric service to our customers at the lowest possible cost. The Oneida Street experiments were a giant step in that direction, proving that coal generating units could be operated more efficiently and that the cost of electrical power could be lowered.

Our company's history is marked by a number of other notable achievements.

The construction and operation in 1882 of the Vulcan Street Power Plant in Appleton, Wis., was one of the first. Built by one of our predecessor companies, the Vulcan Street plant was the first Edison hydroelectric central station in North America. That plant received landmark status from the American Society of Mechanical Engineers, American Society of Civil Engineers and Institute of Electrical and Electronics Engineers in 1977.

The early leaders of The Milwaukee Electric Railway and Light Co., from which Wisconsin Electric evolved, recognized the importance of the Oneida Street experiments. They saw a need to improve service to their customers and supported their employes' efforts to get the job done in an innovative fashion.

That support for employe innovation is not a thing of our past. We always have encouraged creative people to find solutions to the problems facing our industry.

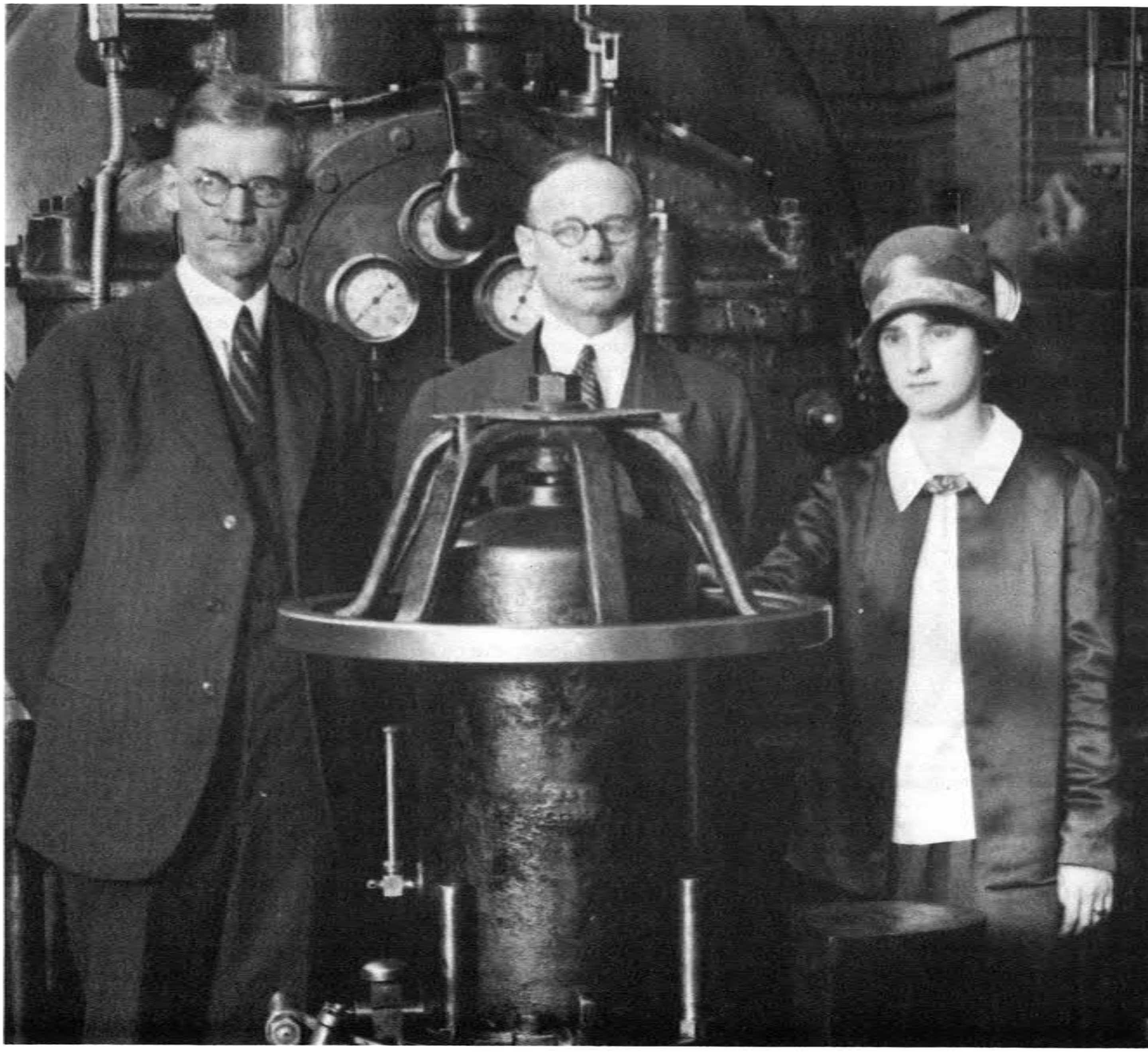
Our company has benefitted from this approach on a number of fronts. The installation of smoke washers and mechanical dust collectors at several of our plants, including East Wells, in the 1930's and early 1940's, were among the first voluntary utility efforts in the environmental arena.

The company also was among the first to experiment with scrubbing devices to remove sulfur dioxide from power plant stack emissions; to work to improve the aesthetics of substation design; and to explore new ways to use electricity more effectively.

Today, we're working to control growth in demand for electricity with the "stored cooling" concept, in which water is frozen during off-peak hours to provide on-peak cooling; with a load managment program under which electric water heaters are turned off remotely during peak-use periods of time; and with a solar water heating program.

We will continue to encourage innovative thinking, testing ideas thoroughly and then applying them for the benefit of our customers, stockholders and employes.

We didn't stop trying to find better ways to serve our customers with the experimentation with pulverized coal at the Oneida Street plant. We've only just begun.



Fred Dornbrook, left, and John Anderson put some of their prior experience as seamen to use in developing the pulverized fuel concept at East Wells (Oneida Street). The two are pictured with Anderson's daughter Miriam at start-up ceremonies for a new unit at Lakeside Power Plant in 1926. Miriam at the time was the only woman mechanical engineering student at the University of Wisconsin.

Seafaring experience sparked revolutionary Oneida experimentation

The early years of central station electric power production were plagued by the growing pains typical to any new technology. Efficiencies were low; unit outages were frequent and accepted; and the quality of coal was becoming poorer, while its cost was increasing.

The industry definitely needed a shot in the arm, if not in the boiler.

During this time, two men, John Anderson and Fred Dornbrook, were getting their education in firing boilers – at sea. Anderson was born in Aberdeen, Scotland; the son of a sea captain. He was educated in the British Government School of Science and Technology, a marine engineer from 1880 to 1906 and later heating superintendent at Union Electric Light and Power Co. of St. Louis. He came to Milwaukee in 1912 as chief engineer at The Milwaukee Electric Railway and Light Company (TMER&L).

His seaman counterpart, Dornbrook, was born in Brandon, Wis. He was a marine fireman and assistant marine engineer before joining TMER&L, where he directed the construction of the Commerce Street Power Plant in Milwaukee in 1903. Dornbrook was named engineer of operations and maintenance of the Power Plant Department in 1914.

At TMER&L, the two men's discussions often centered on what they considered the hardest work either had done aboard ship – stoking a boiler. It was Dornbrook who later related that it was Anderson who seized upon the idea of grinding coal to a fine powder, blowing it into the furnace with large fans and adapting that technology to the production of electricity.

Coal being delivered to East Wells (Oneida Street) by horse and wagon in April 1910.

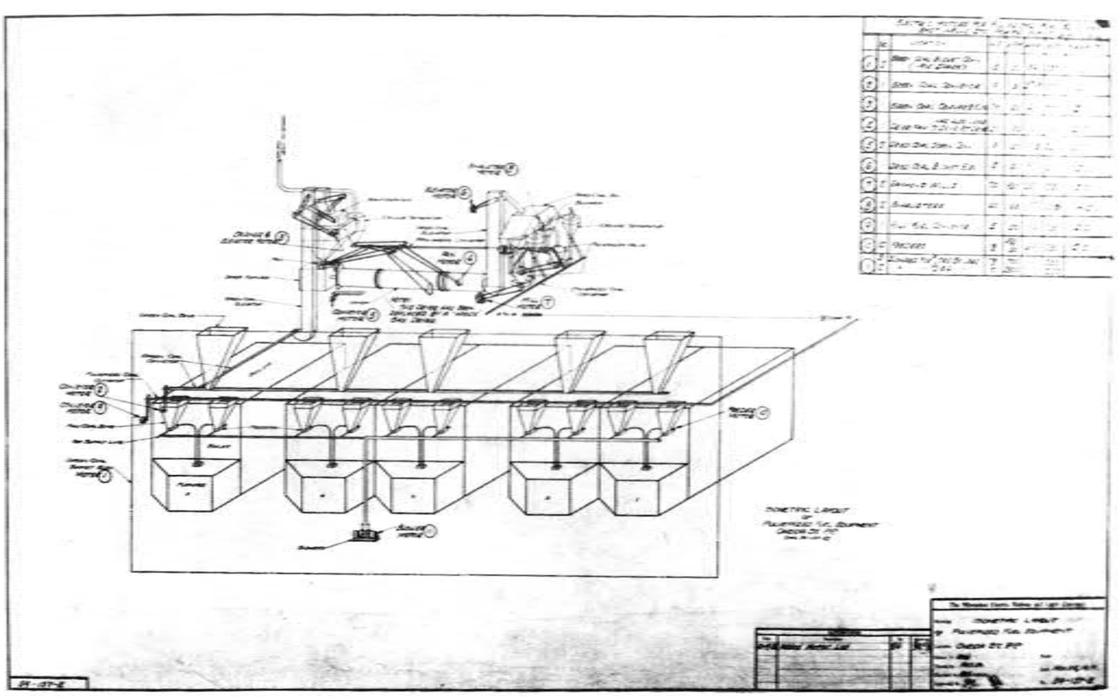
Others' early failures, willing management set the wheels in motion

What they considered was hardly a new idea. As far back as 1876, attempts had been made to burn coal in pulverized form in boilers. The first real degree of success was reached in 1910, when a pulverizer and boiler were installed at a coal-fired power plant in Pittsburgh, Pa. But problems arose because of a lack of furnace volume. Other later attempts in the New York state encountered the furnace volume problem, along with serious slag difficulties.

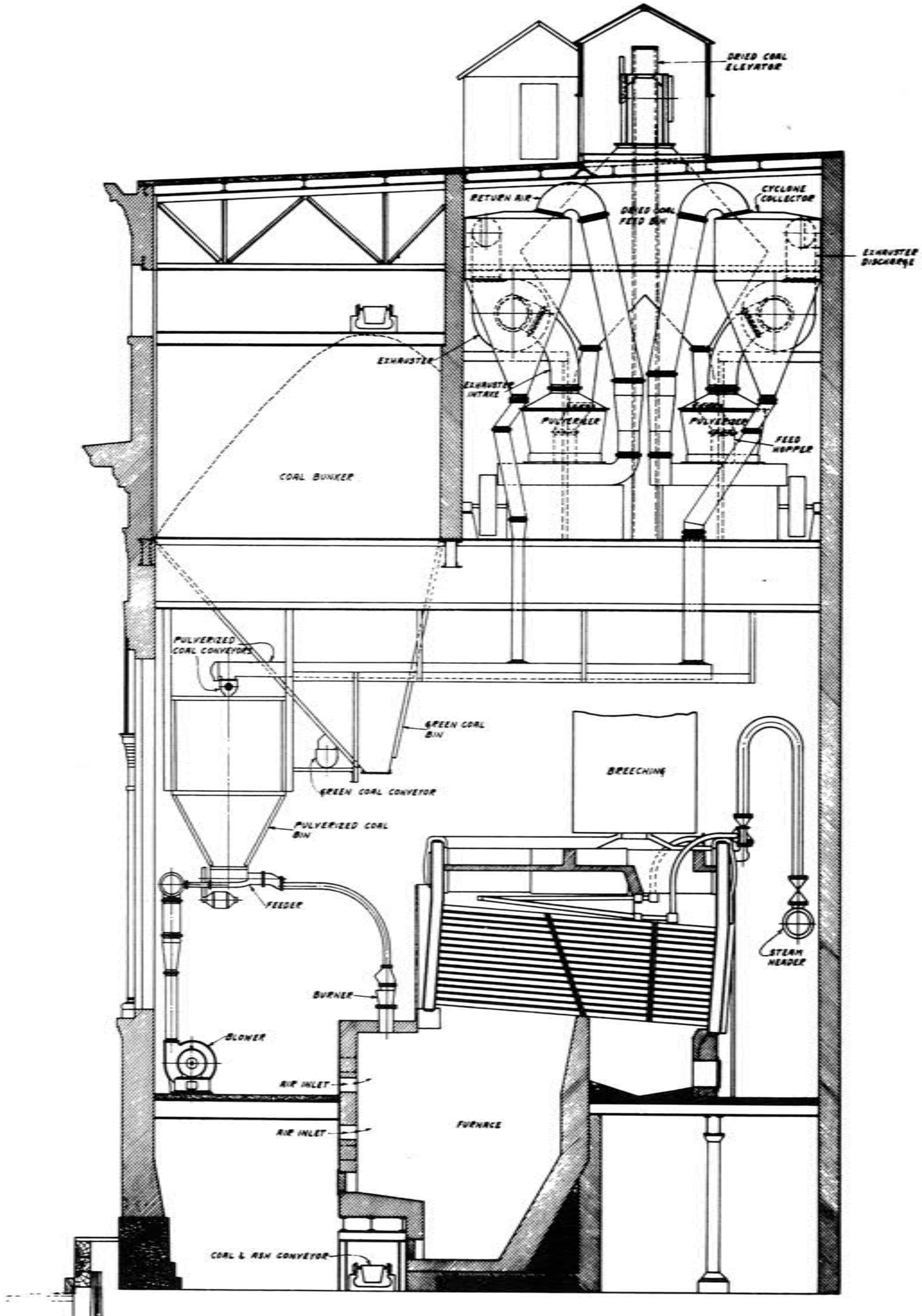
Pulverized coal-firing tests also were made by the Atlas Portland Cement Co., but these were confined only to the production of cement clinker. Pulverized coal also had been burned in annealing and forging furnaces, as well as in the manufacture of refractories, and some work had been done toward the application of pulverized coal to power locomotives and lake steamers.

Anderson and Dornbrook did their homework. They knew they would be presented with unique problems, and that much experimentation would be needed.

Receiving management approval for experimentation with the pulverized fuel concept came quickly. TMER&L management considered it a good business risk to place a boiler at the Oneida Street Power Plant at the disposal of the operating crew for experimental purposes. It felt that, even under these conditions, the boiler would be available when needed.

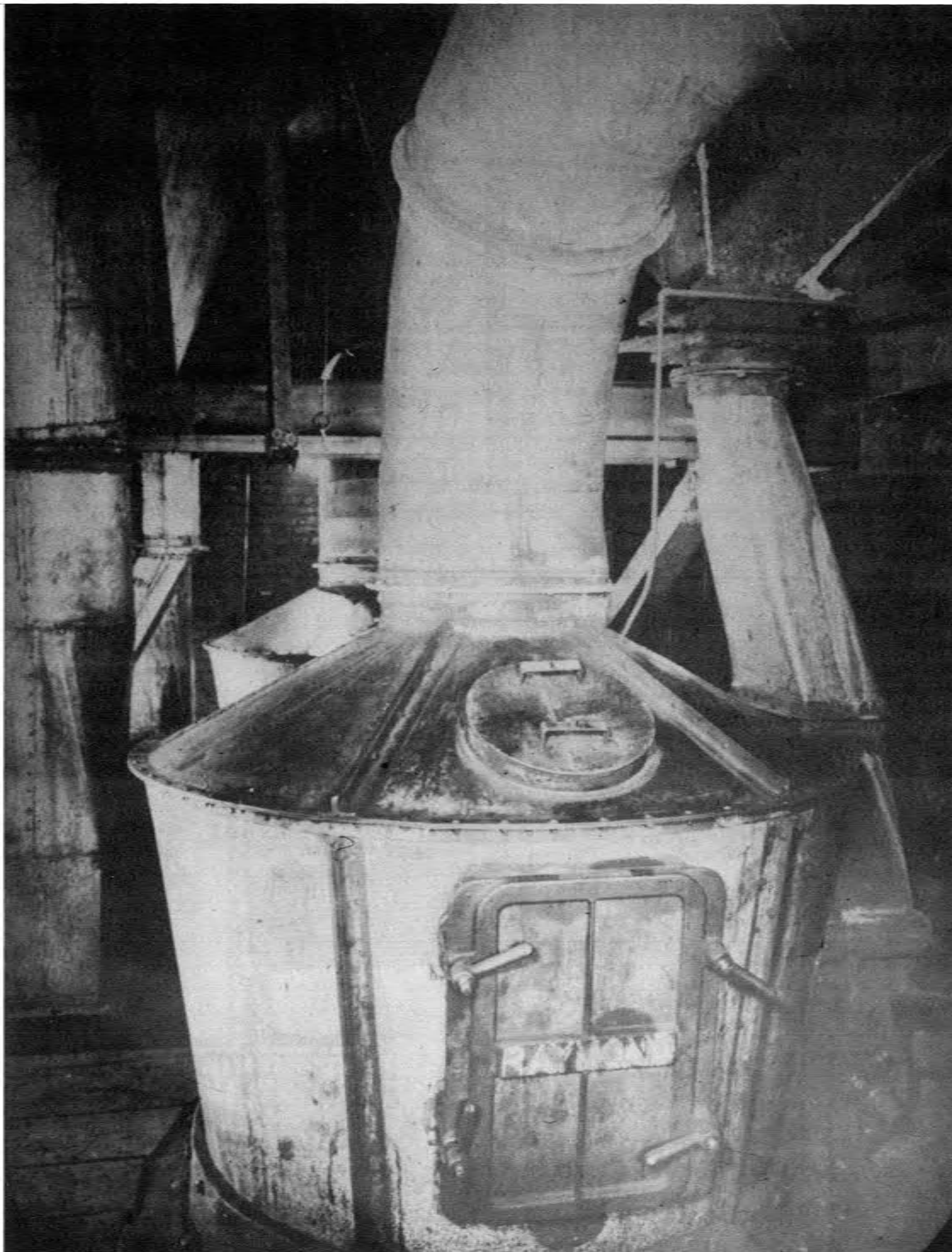


Isometric layout detailing the East Wells (Oneida Street) pulverizing equipment.



CROSS SECTION
LOOKING NORTH

A cross-section drawing detailing the installation of the pulverizing equipment and related systems at East Wells (Oneida Street).



Coal was pulverized in mills before going into the feeder system for burning in the boilers.

The experiments begin: Inventive staff solves 'how to free that slag'

The boiler on which the first tests were performed was a 4,680-square-foot, 468-horsepower Edge Moor water-tube boiler. It originally was fed by Riley underfeed strokers, which inherently were plagued by problems, such as breakdowns in the stokers themselves and having to continually watch the fire to maintain correct and uniform coal-bed thickness.

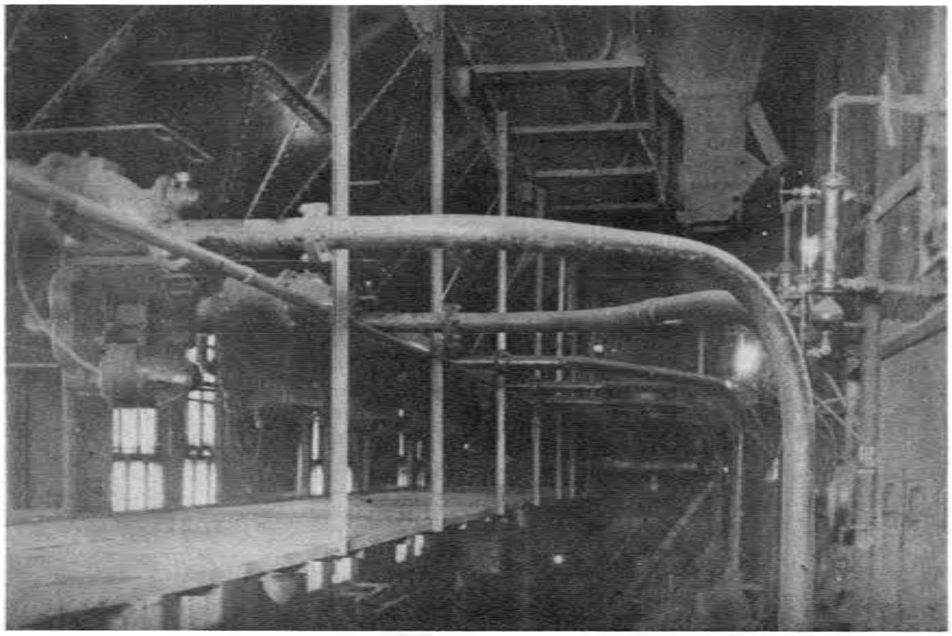
Pulverizing equipment was installed on the plant's third floor, near the battery room. Piping was connected from there to vertical Lopulco (Locomotive Pulverized Fuel Co.) burner boxes.

After preliminary operation, and making certain changes, the installation was found to be so successful that the remaining four boilers in the plant's south end were equipped for pulverized coal.

It was not an easy time for Anderson, Dornbook and company. As they expected, several major problems cropped up. One of the biggest was one encountered elsewhere – slagging in the boiler. Ash at the bottom of the boiler was sticky and fused into a sheet of "slag" covering the entire hearth. The question was "how to free that slag."

The capable and inventive engineering, technical and operating staff finally came upon the idea of running cooling water through pipes at the bottom of the furnace – a water screen, it was called later.

The water screen cooled the slag and prevented the ash from sticking. This change in furnace design, more than any other single item, contributed to the ultimate and permanent success of the modern pulverized fuel-fired furnace, according to Combustion Engineering Magazine.



The coal feeder system brought coal from the hoppers above into the boilers below.

Painstaking process leads to success, changes that become national standards

Anderson and Dornbrook conducted a wide range of tests and experiments on the Oneida Street boilers before a furnace of the proper design was developed. In fact, one boiler was rebuilt five times before they obtained a satisfactory shape and volume.

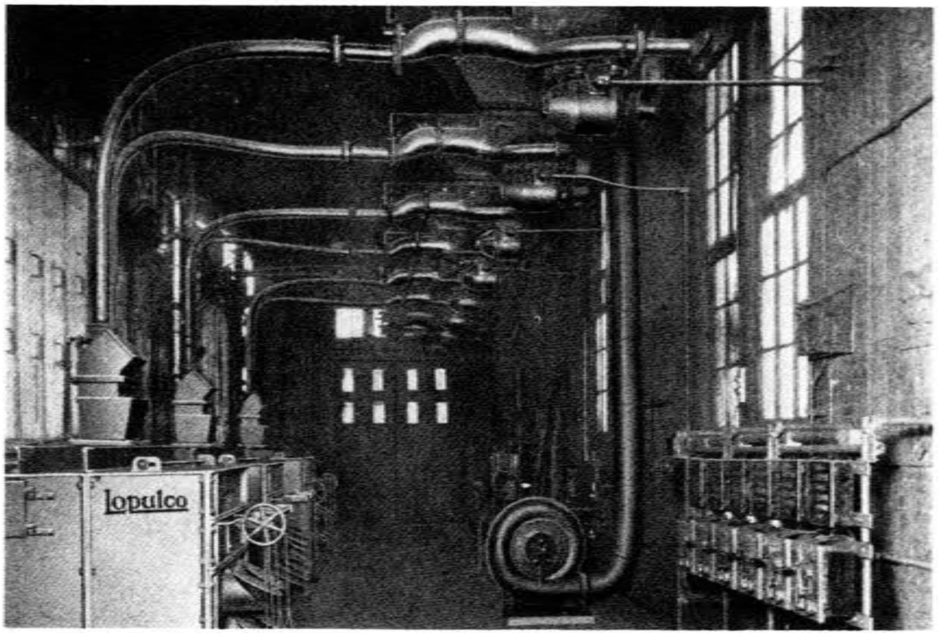
Other major boiler changes had to be made, including drawing secondary air from the boiler room through ports in the front wall. Air flow was controlled by doors in each port. The fuel and primary air were projected downward across the secondary air flow.

One of the most important facets of the Oneida Street experiments is that the test data and operating experiences were published extensively. Earlier tests in other industries across the nation basically were treated as proprietary information and kept secret. This lack of documentation, until the Oneida experiments, hindered the development of pulverized fuel.

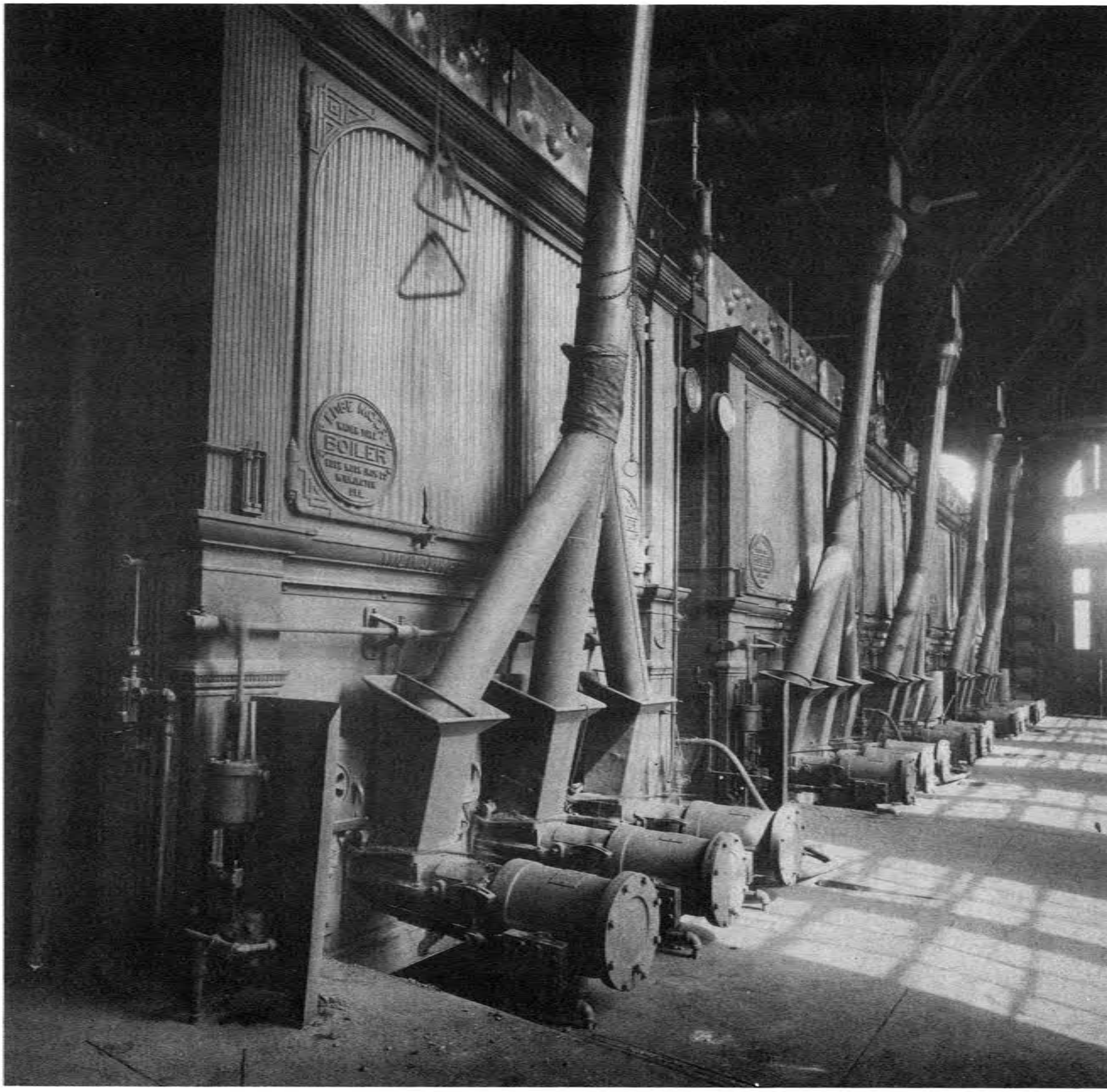
Test engineers from Detroit Edison Co., Foster Wheeler Corp., Combustion Engineering Co. and the U.S. Bureau of Mines took active parts in the monitoring of the experimentation. It was Paul Thompson, Detroit Edison technical engineer, who observed the historic Nov. 11-15, 1919, tests of the pulverized coal system, which showed a gross boiler efficiency of 80.67. A test of a stoker-fired boiler at Oneida showed a gross efficiency of 76.8 percent.

These tests, as stated, resulted in many changes that eventually became the standard in most of the nation's coal-fired power plants.

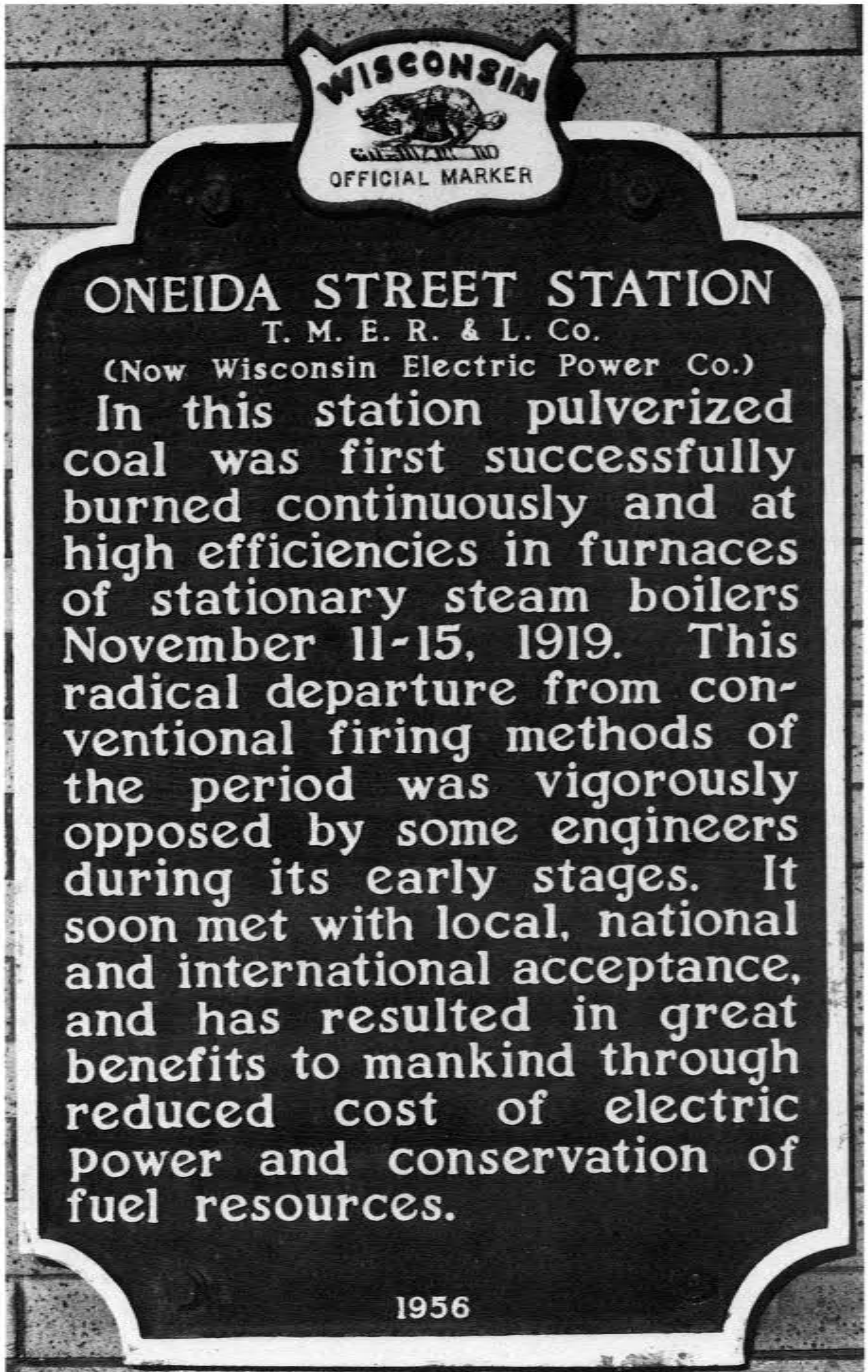
The tests also proved that pulverized coal could be burned at efficiencies unattainable, at that time, in any other way.



Boiler Room No. 1 at East Wells (Oneida Street) as it looked after the changeover from stoker coal to pulverized coal.



Boiler room No. 1 at East Wells (Oneida Street) as it looked in the early 1900s, when stoker coal still was being used to fire the boilers.



The State of Wisconsin recognized East Wells (Oneida Street) as a state landmark in 1956.

Oneida experiments hailed as ranking with Edison, Stanley, Parsons

Historian Forrest McDonald emphasized the importance of the Oneida Street experiments in his book "Let There Be Light."

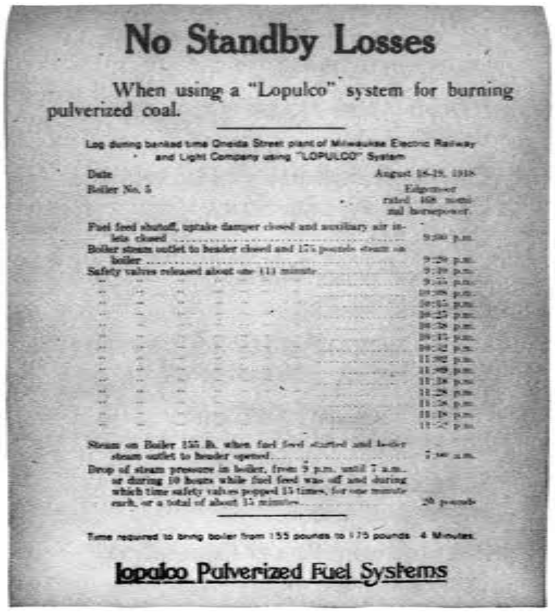
"The development of pulverized fuel and its attendant developments constituted a monumental achievement," he wrote, "ranking with Edison's lamp and multiple distribution system, Stanley's transformer, and Parsons' steam turbine as one of the four fundamental technological developments that made low-cost central-station service possible."

The Oneida Street innovations were incorporated into the Lakeside Power Plant, located in St. Francis, Wis., south of Milwaukee. The plant was built in 1921 by the new Wisconsin Electric Power Co. – a firm established by TMER&L for the sole purpose of operating the Lakeside plant.

A plant designed to burn only pulverized coal, Lakeside's reputation as a bold move in the pioneering of pulverized coal electrical production, as well as its outstanding operating record, were established and gained world reknown.

Both Anderson and Dornbrook rightfully shared in that spotlight. J.M. Drabelle, consulting engineer for Iowa Electric Light and Power Co., indicated in 1941 that "TMER&L Co. and John Anderson are two names which will always be inseparably linked together in the commercial development and use of pulverized coal-firing in large power boilers in this country."

Dornbrook's contributions were recognized by the American Society of Mechanical Engineers in 1949, when he was presented with the ASME Medal for Distinguished Service in Engineering and Science.


No Standby Losses

When using a "Lopulco" system for burning pulverized coal.

Log during banked time Oneida Street plant of Milwaukee Electric Railway and Light Company using "LOPULCO" System

Date — August 18-19, 1918

Boiler No. 5 — Edgemoor rated 468 nominal horsepower

Fuel feed shutoff, uptake damper closed and auxiliary air inlets closed .... 9:00 p.m.

Boiler steam outlet to header closed and 175 pounds steam on boiler .... 9:20 p.m.

Safety valves released about one (1) minute .... [illegible]

Steam on Boiler 155 lb. when fuel feed started and boiler steam outlet to header opened .... [illegible] a.m.

Drop of steam pressure in boiler, from 9 p.m. until 7 a.m., or during 10 hours while fuel feed was off and during which time safety valves popped 15 times, for one minute each, or a total of about 15 minutes .... 20 pounds

Time required to bring boiler from 155 pounds to 175 pounds 4 Minutes

Lopulco Pulverized Fuel Systems

Data prepared on the Aug. 18-19, 1918, banking of boiler No. 5 at the East Wells (Oneida Street) plant.

The National Historic Mechanical Engineering Landmark Program

The American Society of Mechanical Engineers reactivated its history and heritage program in September 1971 with the formation of the National History and Heritage Committee. The committee's overall objective is to promote a general awareness of our technological heritage among both engineers and the general public.

One of the committee's responsibilities is to gather data on all works and artifacts with a mechanical engineering connection that are historically significant to the profession. It's an ambitious goal, and one achieved largely through the volunteer efforts of the section and division history and heritage committees and interested ASME members.

Two major programs are carried out by the sections, under the direction of the national committee. One is a listing of industrial operations and related mechanical engineering artifacts in local historic engineering records, and the other is the national historic mechanical engineering landmark program. The former is a record of detailed studies of sites in each local area, while the latter is a demarcation of local sites which are of national significance — people or events which have contributed to the general development of civilization.

ASME also cooperates with the Smithsonian Institution in a joint project to contribute historic material to the National Museum of History and Technology in Washington, D.C. The Smithsonian's permanent exhibition of mechanical engineering memorabilia is directed by a curator, who also serves as an ex-officio member of ASME's national history and heritage committee.

Other historic landmarks

East Wells (Oneida Street) Power Plant is the 40th landmark to be designated since the program began in 1973. The others are:

Ferries and Cliff House Cable Railway Power House, San Francisco, Calif.

Leavitt Pumping Engine, Chestnut Hill Pumping Station, Brookline, Mass.

A.B. Wood Low-Head High-Volume Screw Pump, New Orleans, La.

Portsmouth-Kittery Naval Shipbuilding Activity, Portsmouth, N.H.

102-Inch Boyden Hydraulic Turbines, Cohoes, N.Y.

5000 KW Vertical Curtis Steam Turbine-Generator, Schenectady, N.Y.

Saugus Iron Works, Saugus, Mass.

Pioneer Oil Refinery, Newhall, Calif.

Chesapeake & Delaware Canal, Scoop Wheel and Engines, Chesapeake City, Md.

U.S.S. Texas, Reciprocating Steam Engines, Houston, Texas

Childs-Irving Hydro Plant, Irving, Ariz.

Hanford B-Nuclear Reactor, Hanford, Wash.

First Air Conditioning, Magma Copper Mine, Superior, Ariz.

Manitou and Pike's Peak Cog Railway, Colorado Springs, Colo.

Edgar Steam-Electric Station, Weymouth, Mass.

Mt. Washington Cog Railway, Mt. Washington, N.H.

Folsom Power House #1, Folsom, Calif.

Crawler Transporters of Launch Complex 39, J.F.K. Space Center, Fla.

Fairmont Water Works, Philadelphia, Pa.

U.S.S. Olympia, Vertical Reciprocating Steam Engines, Philadelphia, Pa.

5-Ton "Pit-Cast" Jib Crane, Birmingham, Ala.

State Line Generating Unit #1, Hammond, Ind.

Pratt Institute Power Generating Plant, Brooklyn, N.Y.

Monongahela Incline, Pittsburgh, Pa.

Duquesne Incline, Pittsburgh, Pa.

Great Falls Raceway and Power System, Paterson, N.J.

Vulcan Street Power Plant, Appleton, Wis.

Wilkinson Mill Pawtucket, R.I.

New York City Subway System, New York, N.Y.

Baltimore & Ohio Railroad, Baltimore, Md.

Ringwood Manor Iron Complex, Ringwood, N.J.

Joshua Hendy Iron Works, Sunnyvale, Calif.

Hacienda La Esperanza Sugar Mill Steam Engine, Manati, Puerto Rico

RL-10 Liquid-Hydrogen Rocket Engine, West Palm Beach, Fla.

A.O. Smith Automated Chassis Frame Factory, Milwaukee, Wis.

Reaction-Type Hydraulic Turbine, Morris Canal, Stewartsville, N.J.

Experimental Breeder Reactor (EBR-1), Idaho Falls, Idaho

Drake Oil Well, Titusville, Pa.

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