SPICER MANUFACTURING COMPANY, SOUTH PLAINFIELD WORKS, BUILDINGS 9 AND 30
(Powerhouse and Water Softener Building)
333 Hamilton Avenue
South Plainfield
Middlesex County
New Jersey

HAER NJ-144-J
HAER NJ-144-J

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
1849 C Street NW
Washington, DC 20240-0001

HISTORIC AMERICAN ENGINEERING RECORD

SPICER MANUFACTURING COMPANY, SOUTH PLAINFIELD WORKS, BUILDINGS 9 AND 30
(Spicer Manufacturing Company, South Plainfield Works, Powerhouse and Water Softener Building)
HAER No. NJ-144-J

Location: 333 Hamilton Avenue
Borough of South Plainfield
Middlesex County
New Jersey

U.S. Geological Survey Plainfield Quadrangle
UTM Coordinates 18.549712.4491934

Dates of Construction: c1914-1919

Present Owners: DSC of Newark Enterprises, Inc.
70 Blanchard Street
Newark, NJ 07105

Present Use: Demolished

Significance: The South Plainfield Works, originally developed by the Spicer Manufacturing Company beginning in 1910, was a nationally-significant center for the manufacture of universal joints and propeller shafts for automobiles and aircraft. Building 9 provided the plant with electric power for lighting and manufacture, steam for heating, and compressed air. Building 30 supported the powerhouse boilers with water softening equipment.

Project Information: Surviving structures of the former South Plainfield Works were part of the Cornell-Dubilier Electronics Superfund Site, and were demolished in 2007-2008 as part of site remediation activities outlined in the September 2004 Record of Decision as administered by the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers. Federal authority brought the project under the purview of federal acts and regulation protecting significant cultural resources from adverse project effects.[*] Prior to demolition, the Spicer Manufacturing Corporation structures were determined eligible for inclusion on the National Register of Historic Places by the New Jersey State Historic Preservation Office, because of the South Plainfield Works' significance in American transportation history. Documentation of the plant to standards of the Historic American Engineering Record was completed to mitigate the removal of the significant resources.

[*] National Historic Preservation Act of 1966 (PL 89-655), the National Environmental Policy Act of 1969 (PL 91-190), the Archaeological and Historical Preservation Act (PL 93-291), Executive Order 11593, Procedures for the Protection of Historic and Cultural Properties (36 CFR Part 800).

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Building Descriptions and Construction History

Building 9 - Power House

Original Construction

From c1910-1914, Spicer Manufacturing Company had no power plant at its South Plainfield factory, and met its forging, machining, heat treating, and heating requirements from public electric utility lines and other power sources such as small boilers. During the first large expansion of the plant c1914-16, a coal-fired powerhouse approximately 84 by 56 feet in plan was completed with associated facilities including a condenser pond on Bound Brook, a deep well pump between the powerhouse and the brook, and a steam-powered fire pump and 100,000-gallon elevated steel water tank adjacent to the southeast side of the powerhouse. Four riveted box-section steel legs, with steel beam and cable bracing, raised the tank approximately 50 feet above the ground. The powerhouse's 12-inch-thick brick-pier walls on reinforced-concrete foundations originally enclosed a boiler room approximately 49 feet long and a turbine-generator room approximately 34 feet long. A 5-foot-inside-diameter, 150-foot-high reinforced concrete stack was centered about 13 feet from the center of the southwest facade.[*] The original powerhouse exterior, some of which survived in 2007, had a reinforced-concrete base exposed approximately 6.7 feet above the surface and rose to heights of 22 to 24 feet with dentillated brick cornices and ceramic-topped parapets. Rectangular 6-by-7-light, fixed and movable steel-sash windows, typically 7.2 feet wide and 10-to-10.8-feet high with concrete sills and lintels, defined four bays on the short sides of the building and seven bays on the long northeast facade. There are no surviving views of the original southwest facade. Longitudinal steel I-beams 19 inches high, centered between windows on 26-inch-wide piers, supported composition roofing which sloped down towards the southeast above the turbine-generator room; original boiler room ceiling and roof components were removed beginning in 1918 (Figures 1-4, 8; Spicer Manufacturing Company 1913, 1915; Dunham-Clarin Company 1917; Spicer Manufacturing Corporation 1918b; Photographs HAER No. NJ-144-4, HAER Nos. NJ-144-J-1, NJ-144-J-3, NJ-144-J-7).

The boiler and turbine-generator rooms were separated by a 17-inch-thick brick wall penetrated by circular portals for steam pipes discussed below, and by a man-door. The dividing wall rested on a 5-foot-high reinforced-concrete base which extended to the bottom of the 8.5-foot-high basement of the turbine-generator room. The basement, with 19-to-26-inch-thick reinforced-concrete walls, had three 7.3-foot-high reinforced-concrete bases for turbine-generator and air compressor units discussed below, above which 10- and 14-inch I-beams supported the concrete base of the turbine-generator room floor. A narrow stairway near the rear of the room, subsequently removed, linked the two levels. There were four 32-to-34-inch wide, 26-inch-high windows installed in the southeast wall, beginning 5.3 feet above the floor, which once provided some light from the exterior. Beneath the water tank, a 23.5-foot-long extension of the basement evidently housed the fire pump, and intake pipes from the tank and municipal water supply. The height of the basement, driven by the placement of condensers in the turbine-generator bases, put the boiler room floor 4 feet above the basement floor and 4 feet below the main floor of the turbine-generator room. A metal stair in the boiler room at the door between the two rooms accommodated the difference in floor levels. The turbine-generator floor may have been surfaced with stone blocks (Figures 7-8; Spicer Manufacturing Corporation 1918b; Photograph HAER No. NJ-144-J-8).

[*] Reinforced concrete stacks were common features of central power plants before World War I (e.g., Fernald and Orrok 1916: 171).

1918 Expansion

Powerhouse capacity was reportedly doubled in 1918, with new boilers, mechanized coal and ash handling facilities, associated re-alignment of rail spurs, and a new turbine-generator as discussed below. The southeast half of the boiler room, with the original boilers, was evidently left structurally unchanged, but the remaining boiler room was rebuilt with a 150-ton concrete coal bunker[*], and the structure was lengthened 16 feet to the northwest and raised to accommodate additional boilers and an ash bin. A second 150-foot-high concrete stack, with an 8-foot interior diameter, was built adjacent to the southwest corner of the enlarged boiler room. The raised sections of the northeast exterior boiler room wall were in brick with no decorative treatment, and the new 31-foot-high northwest wall consisted of a reinforced-concrete base similar to that of the original boiler room exterior, with brick above including a dentillated cornice and a ceramic-pipe-topped parapet. There were three 7.4-by-14.8-foot fixed and movable steel-sash windows in the new northwest wall, probably first built with 6-by-10 lights; the section of this wall nearest the 1918 stack had a 6.4-by-14.4-foot opening for breeching from the added boilers. One original window on the northeast wall was removed, and two windows of the same size were installed in the added section of this wall. The reconstructed southwest wall was probably timber-framed above a 12-inch-high brick base, with undocumented exterior treatment which may have been stucco, two 7.4-by-9.7-foot, 6-by-7-light steel sash windows, and one similar 6-by-6-light window approximately 8.3 feet high. Historic images show no exterior doors on the reconstructed boiler room. The turbine-generator room and basement were lengthened 15.8 feet to the southwest for the additional turbine-generator, with an operating floor at the original elevation and most of the basement floor 1.3 feet below the remainder of that space. The additional turbine-generator room exterior included an undecorated brick northwest wall, a brick southeast wall with dentillated cornice matching the original wall on this side with a window identical to original ones, and a southwest facade similar to that of the analogous new boiler room wall with a 2.8-foot-high brick base which was the top of an approximately 10-foot high wall defining the end of the basement addition. Openings in the new southwest turbine-generator wall included a 6-by-7-light steel sash window approximately 7.5 by 10.5 feet, and a hinged 8-by-10-foot door beneath a 6-by-4-light steel sash window approximately 4.3 by 8 feet (Figures 4-8; Spicer Manufacturing Corporation 1923, 1926; Photographs HAER No. NJ-144- 4, HAER Nos. NJ-144-J-1-3).

Field documentation in 2007 of the surviving boiler room interior was limited by safety and contamination issues, but use of available historical images as well as measurements taken from large-format photographs allowed for relatively complete recording. As rebuilt in 1918, the boiler room was 65 feet long and had three asymmetrical transverse bays. The 23.2-wide southeast bay, with the original boilers, retained the walls, windows, and roof of the structure completed in 1916. The 15.5-foot-wide central bay rose approximately 40 feet above the ground with a shallow-pitch gable roof to accommodate the 4-foot-high coal bunker and a brick-sided, 9.5-foot-high area above the bunker, which likely had a central coal distributor and a walkway along the southeast side of the distributor.[**] The central bay was supported by 25-by-16-inch concrete and/or

[*] Available information conflicts, with bunker capacity reported as 70 tons (Spicer Manufacturing Company 1918b) and 150 tons (Day 1929). Estimated bunker dimensions (see Figure 8), and bulk density ranges for the bituminous coal most likely used at this plant (45-55 lb/cu. ft), suggest the capacity of the approximately 4900 cubic feet of the rather shallow, straight-sided bunker was closer to the larger figure cited (cf. Babcock and Wilcox Company 1963: 15-4).

[**] This area was not accessible during the 2007 documentation fieldwork, but arrangements are inferred from ground and scissor-lift inspection, and from study of similar installations elsewhere such as the demolished Colgate & Co. powerhouse in Jersey City (HAER No. NJ-71-T, see Raber *et al*. 1991).

composite riveted 18-by-12-inch steel columns, and horizontal 18- and 12-inch I-beams between the columns and beneath the bunker. The walkway, with a platform surface probably 30.5 feet above the boiler room floor, had six double-hung windows, and was accessed from below through a doorway at the northeast end of the walkway. A door at the northeast end of the walkway platform led to a 17.5-foot-long, 6.7-foot-wide steel platform centered on the northeast boiler room wall, and originally enclosed within a steel-and-wood-framed housing. As discussed below, this platform supported part of the conveying system bringing coal to the bunker, and in 2007 retained a motor used to run the conveyor and/or an ash disposal system (Figure 8; Photographs HAER Nos. NJ-144-J-4 through NJ-144-J-6).

At the northwest end of the boiler room, the third bay was 26.4 feet wide. The front interior 45 feet, where the 1918 boilers were installed, had 10-inch I-beam roof supports running at 10-foot centers between the coal bunker and the southwest wall, with the roof beam ends at the bunker approximately 29.5 feet above the floor resting on the horizontal steel bunker support beam. The roof above the boilers included a reinforced-concrete section approximately 15 feet wide which sloped down slightly towards the northwest, and an 11-foot-wide, largely metal-framed and metal-sided raised section which rose approximately 37 feet above the floor adjacent to the coal bunker. At the north corner of the northwest bay, a 20.5-by-9-foot, 18-foot-high steel-framed brick headhouse rose to an elevation of approximately 39.5 feet above the floor and abutted the coal bunker. Most likely an ash bin as described below, the headhouse was supported inside the boiler room by 18-inch I-beams along northwest and southwest sides, the powerhouse exterior wall, and smaller I-beams. One of the large I-beams ran from the exterior wall to a corbelled pilaster between windows, and the second large beam ran from the first beam to a column supporting the coal bunker (Figures 5, 8; Photographs HAER No. NJ-144-H-1 and HAER Nos. NJ-144-J-2, NJ-144-J-5).

In the turbine-generator room basement, the southwest wall was all brick as noted above, the southeast wall was reinforced concrete with a window matching those in the original basement, and the northwest wall had a 7.5-foot-high reinforced-concrete base below a 1.3-foot-high brick section which continued to the top of the addition superstructure. A 7.3-foot-high reinforced-concrete turbine-generator base was topped with two composite steel-and-concrete 1.3-by-1.6-foot horizontal beams which extended to the tops of two 10-by-9-inch, 7.3-foot-high I-beam columns. From the southeast side of the base, a steel-framed metal vent extended to the basement window, as discussed below (Figure 9).

Post-1929 Alterations

Aside from the coal bunker, and a motor and sheave probably associated with coal and ash handling on the platform on the boiler house northeast wall, virtually all powerhouse operating equipment used by the Spicer companies was removed at undocumented times after c1929. The openings in the turbine-generator room floor for the three generating units, an air compressor, and a stairway to the basement were filled with concrete. The 1918 sections of the southwest walls of both rooms were largely covered with brown textured plywood, and modified with new or altered doors including a roll-up door added to the central boiler room bay. The roof of the southeast boiler room bay was removed, and replaced with a high, open metal-framed, metal-sided space, at the northeast end of which an insulated tank for undocumented purposes was set on a steel grate platform approximately 21.5 feet above the floor. A wood-framed, wood-sided bathroom enclosure was also added below this platform (Figure 8; Photographs HAER Nos. NJ-144-J-1, NJ-144-J-3).

Building 30 - Water Softener Building

Water treatment plants to control feedwater and boiler-water became common components of central power stations in the first two decades of the 20th century (e.g., Babcock and Wilcox Company 1963: 21-19 ff). There is no direct evidence that the powerhouse of the South Plainfield Works had such a plant when first built, or when enlarged in 1918; maps and images of the powerhouse prior to 1926 show only a small, unidentified detached frame building near the turbine-generator room and the water tank. By 1926, Building 30 was constructed adjacent to the turbine-generator room southeast of the water tank for undocumented water softener equipment. This windowless, flat-roofed 31-by-21-foot, 13.5-foot-high structure, with an angled south wall to accommodate a rail spur, had 8-inch-thick concrete and tile block walls. A 31-foot-long, 13.5- and 17-foot-wide room of similar height and construction was added immediately to the northeast c1926-1928 for undocumented purposes, enclosing one leg of the water tank. Sometime after 1929, a crude wooden stairway from Building 30 into the turbine-generator room basement was created by breaching the basement wall and removing part of the floor and interior partitioning in Building 30 (Figures 3-4, 7-9; Photographs HAER Nos. NJ-144-J-3, NJ-144-J-9; cf. Spicer Manufacturing Company 1913, Dunham-Clarin Company 1917, Spicer Manufacturing Corporation 1923, Day 1929).

Power Plant Operations

As first constructed, the powerhouse had four 150-hp hand-fired water-tube boilers supplied by the Stirling Consolidated Boiler Company. Stirling boilers (invented in the 1880s) had an advanced water-tube design with three steam/water drums connected with steeply-inclined bent tubes that directly entered the drums. In 1906, the Babcock and Wilcox Company, which already had its inclined straight-tube, water-tube boiler on the market, bought out the Stirling company (Figure 10; Babcock and Wilcox Company 1963: 5). The coal was probably brought to the factory in hopper cars on a siding running past the southeast side of the powerhouse, and dumped in large mounds which appear in a 1915 view. Powerhouse workers had to dump the coal in front of boiler fire boxes by barrow, clean out ashes by hand, and dump the ashes outside (Figure 2; Spicer Manufacturing Company 1915; Spicer Manufacturing Corporation 1918b).

The dividing wall between the boiler room and the turbine room was pierced with 14-inch-diameter circular portals for steam pipes that would have been taken off a header connecting all the boilers. The pipes probably were suspended from the ceiling as they dropped down to connect with the stop valves of the turbines (Figure 11). Two pipes supplied two 500-kw turbine-generators, and a third supplied a steam-powered air compressor most likely located at the northeast end of the turbine generator room on (or in the vicinity of) a 2-foot-high concrete base. The high foundation in the basement under the presumed air compressor suggests that the unit was a large cross-compound rotative air compressor. Spaces between each set of turbine foundation walls and columns contained a jet or surface condenser. While there were no condensers present in 2007, the presence of 12- and 5-inch-diameter pipes in a trench running under the floor between the foundations, and a poorly-documented condenser pond shown on a 1917 map, confirms that the units ran with condensers which greatly increased the efficiency.* There is no information on the type and location of any circulating pumps which would have drawn cooling water from the pond, forced it though the tubes

*Jet condensers cooled the steam in a tank with a direct spray of water. In surface condensers a water flow in a tube bank condensed surrounding steam in a tank without mixing. An alternative condensing system (barometric) would have utilized vertical towers bolted to the outside of the building and would not have required space under the turbines.

of surface condensers, and discharged it to the river. If jet condensers were used, a condenser pond with a sufficiently high surface elevation could have provided natural flow through the units. The 1000-gpm fire pump installed in the original powerhouse basement was probably an Underwriters type pump designed for complete reliability (Figures 3, 8-9; Fernald and Orrok 1916: 100; Dunham-Clarin Company 1917; Spicer Manufacturing Corporation 1918b; Photograph HAER No. NJ-144-J-8).

The 1918 powerhouse expansion included two 300-hp Stirling boilers in the new northwest boiler room bay, equal in capacity to the four original boilers which remained in service. The overhead coal bunker fed all six boilers by gravity, with the larger boilers equipped with underfeed automatic stokers which pushed coal up into the fire bed from below (Figure 10). The old boilers were probably converted to stoker firing at that time with overfeed stokers feeding coal over the fire. Coal arrived by rail car on a new spur running along the northeast side of the powerhouse, and was dumped into a pocket between the tracks equipped with a coal crusher. From the pocket, coal was probably moved almost vertically by bucket elevators and conveyors to the distributor above the coal bunker. Steam ejection removed ash from the boilers via several conveyors to an ash bin on the roof, surmised to be the brick headhouse at the northern boiler room corner. From the bin, chutes dropped ash into railroad cars. The inaccessible motor and sheave on the elevated steel platform seen in 2007 may have powered the coal-feeding mechanism from the pocket below the tracks, or may have been used to maneuver the chutes from the ash bin (Figures 5-6, 8; Spicer Manufacturing Corporation 1918b, 1926; Day 1929; Nalls 1940; Photographs HAER Nos. NJ-144-J-4, NJ-144-J-5).

Expansion of the turbine-generator room accommodated a 1000-kw unit. Although the foundation for the added unit was smaller than the earlier foundations, the much larger capacity of the 1918 unit reflected the rapid strides in turbine generator development in the period around World War I. The inclusion of a ventilation trunk running from the southeast basement wall to a plenum around the base of the generator suggests a unit with greater capacity. The older generators were probably cooled with ambient air.

The turbine-generator room evidently did not have a traveling bridge crane, but did include 12-inch I-beam supports for hoists used during repair work, anchored perpendicular to the roof beams and running over the turbine locations (Figure 8; Photograph HAER No. NJ-144-J-7). The turbine-generators provided AC power which was distributed through a switchboard to the rest of the plant, with some of the power possibly converted to DC for manufacturing operations as discussed in HAER No. NJ-144. In addition to providing electrical power and compressed air, the boilers also fed an extensive network of undocumented underground steam pipes to other plant buildings. By 1929, other equipment in place at undocumented plant locations included a 220 General Electric generator driven by an unidentified prime mover, a Skinner Engine Company steam engine driving an 80-kw Fairbanks-Morse generator for auxiliary lighting, and an additional air compressor which may have been electrically powered (Day 1929; Photograph HAER No. NJ-144-5).

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1918b What is a Power House? *The Drive Shaft* II, 12: 4-5. December. Original in the collections of The History Factory, Chantilly, Virginia. Archive Number 5-4-0-0-1-1 (432).

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1926 Department and Building Location Plan, Spicer Manufacturing Corporation, South Plainfield, New Jersey. Original in the collections of The History Factory, Chantilly, Virginia. Archive Number 5-4-0-0-(432).

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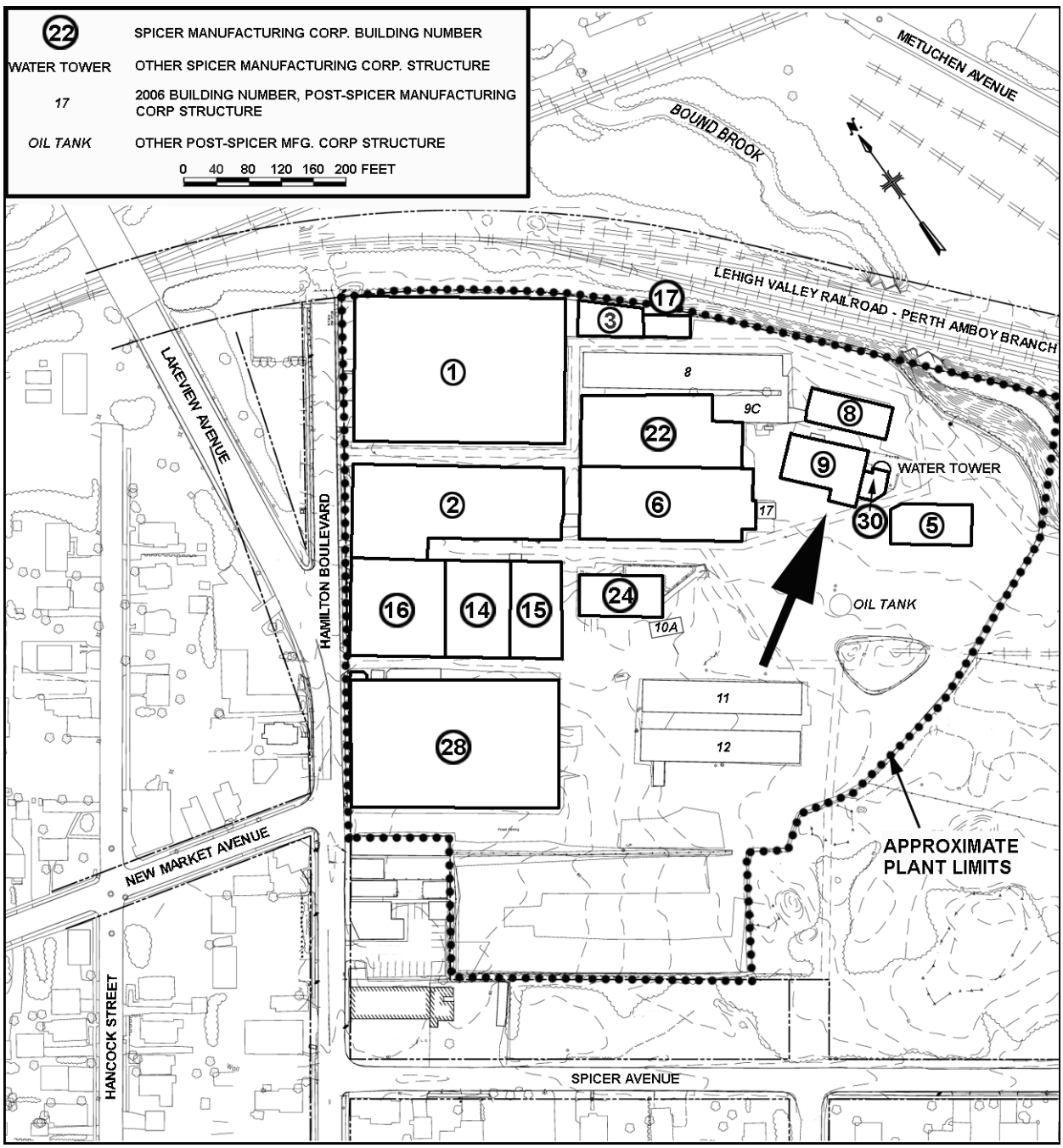

Figure 1. BUILDINGS 9 & 30 LOCATION AT FORMER SPICER MANUFACTURING CORP. PLANT

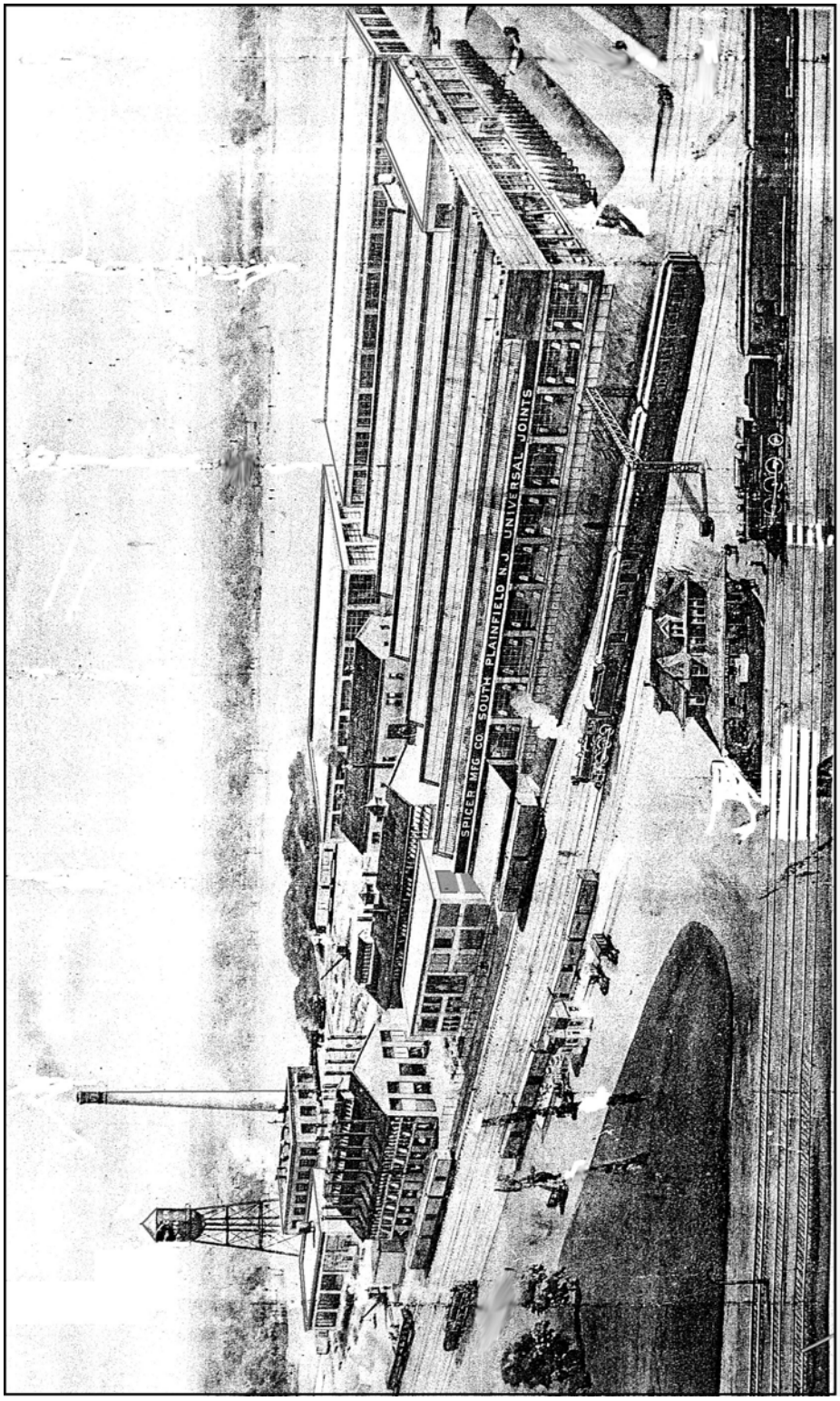

Figure 2. BIRD'S-EYE VIEW TO SOUTH OF SPICER MANUFACTURING COMPANY PLANT c1915
Powerhouse is immediately right of water tank, in front of concrete stack. Large coal piles are visible to right of powerhouse.
source: Spicer Manufacturing Company 1915

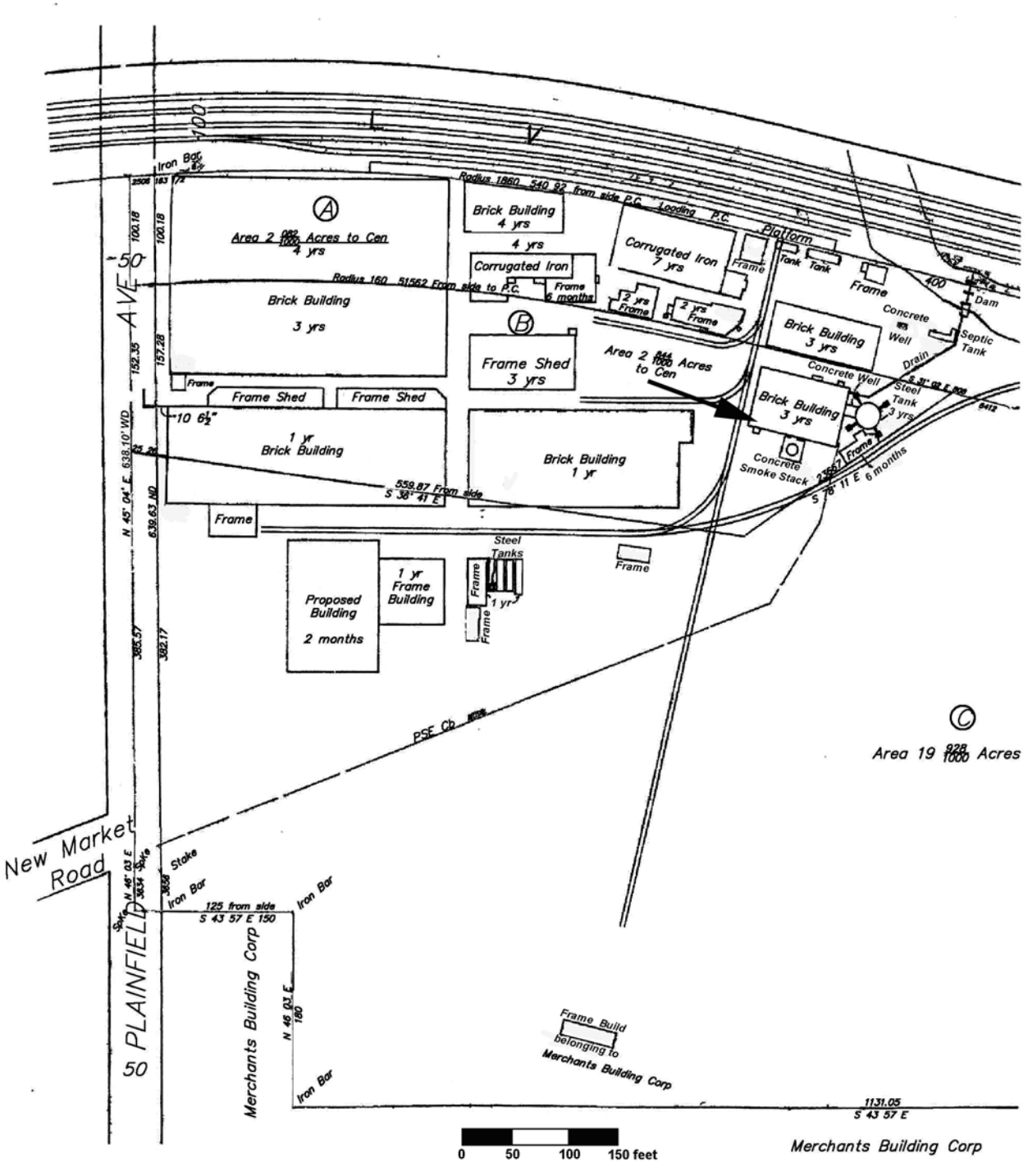

Figure 3. BUILDING 9 AND 1917 SOUTH PLAINFIELD WORKS
Source: Dunham-Clarin Company 1917, with re-lettering

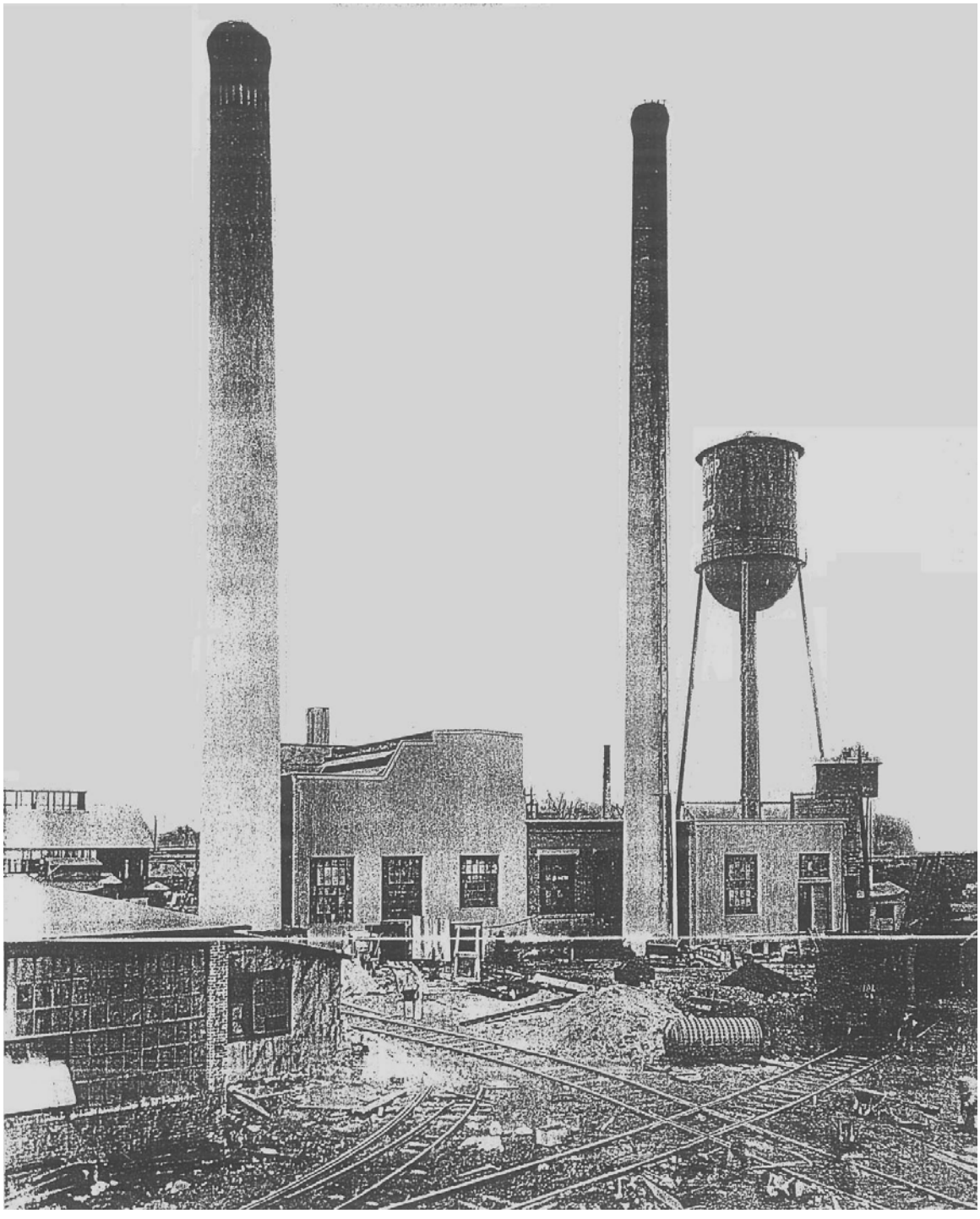

Figure 4. 1918 VIEW EAST OF RECONSTRUCTED BUILDING 9
Source: Spicer Manufacturing Corporation 1918b

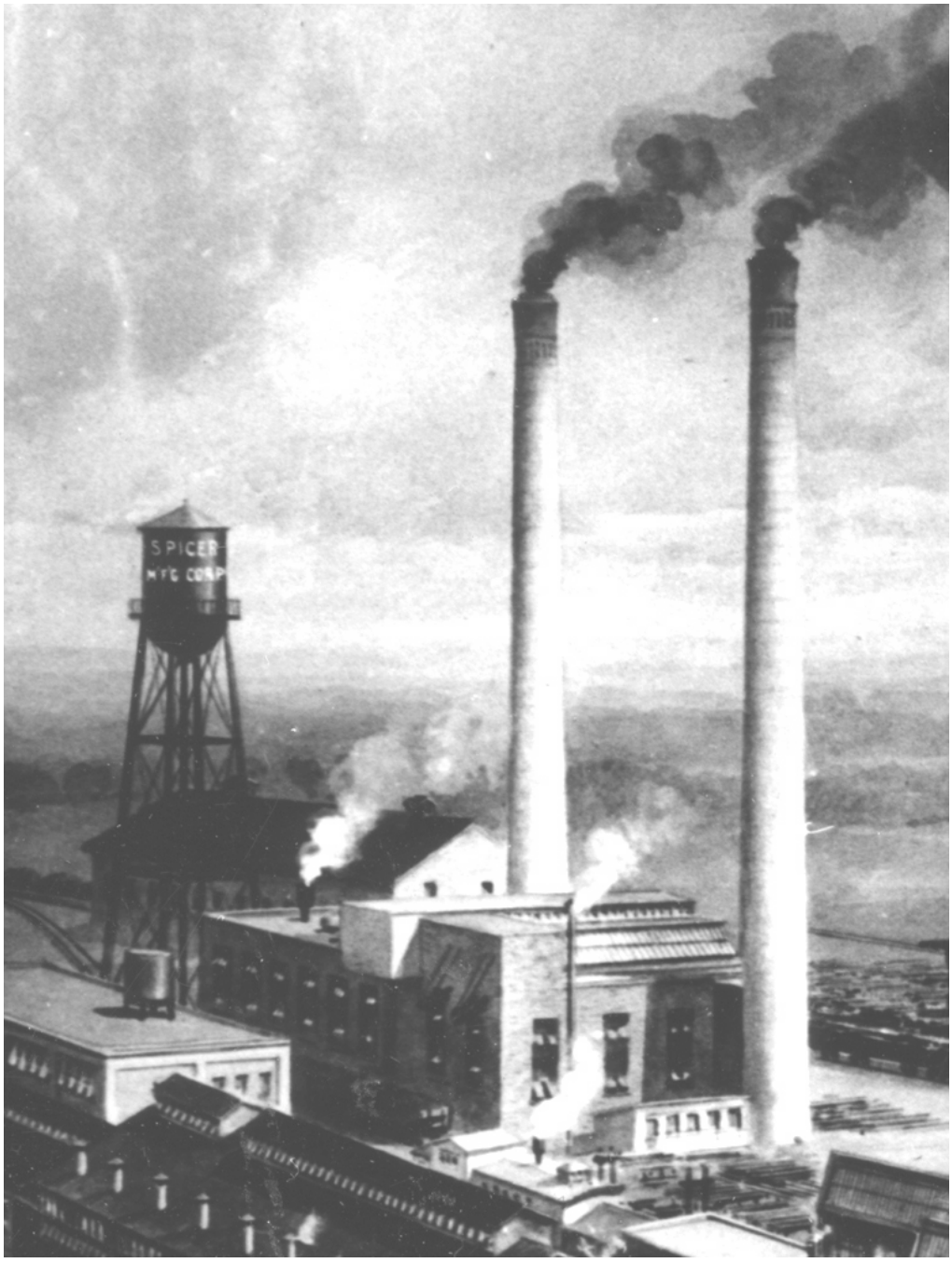

Figure 5. DETAIL TO SOUTH OF BUILDING 9 IN 1923
Source: Spicer Manufacturing Company 1923
Concrete stack at right built 1918, with breeching to 1918 boilers visible. At right center, enclosed platform at end of distributor for coal bunker extends beyond powerhouse northeast wall; headhouse to right with chutes retained by wires was probably ash bin for disposal into rail cars.

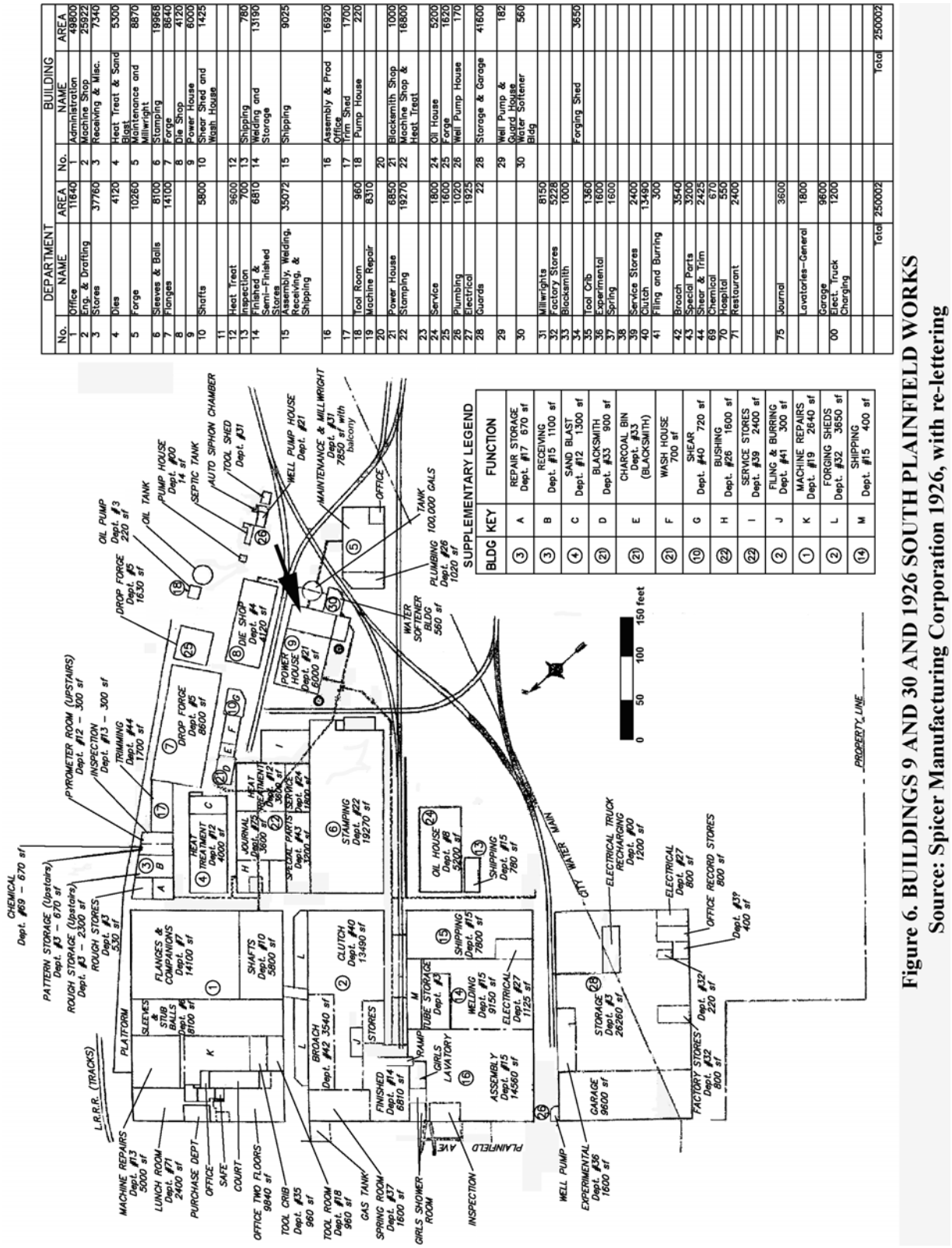

Figure 6. BUILDINGS 9 AND 30 AND 1926 SOUTH PLAINFIELD WORKS
Source: Spicer Manufacturing Corporation 1926, with re-lettering

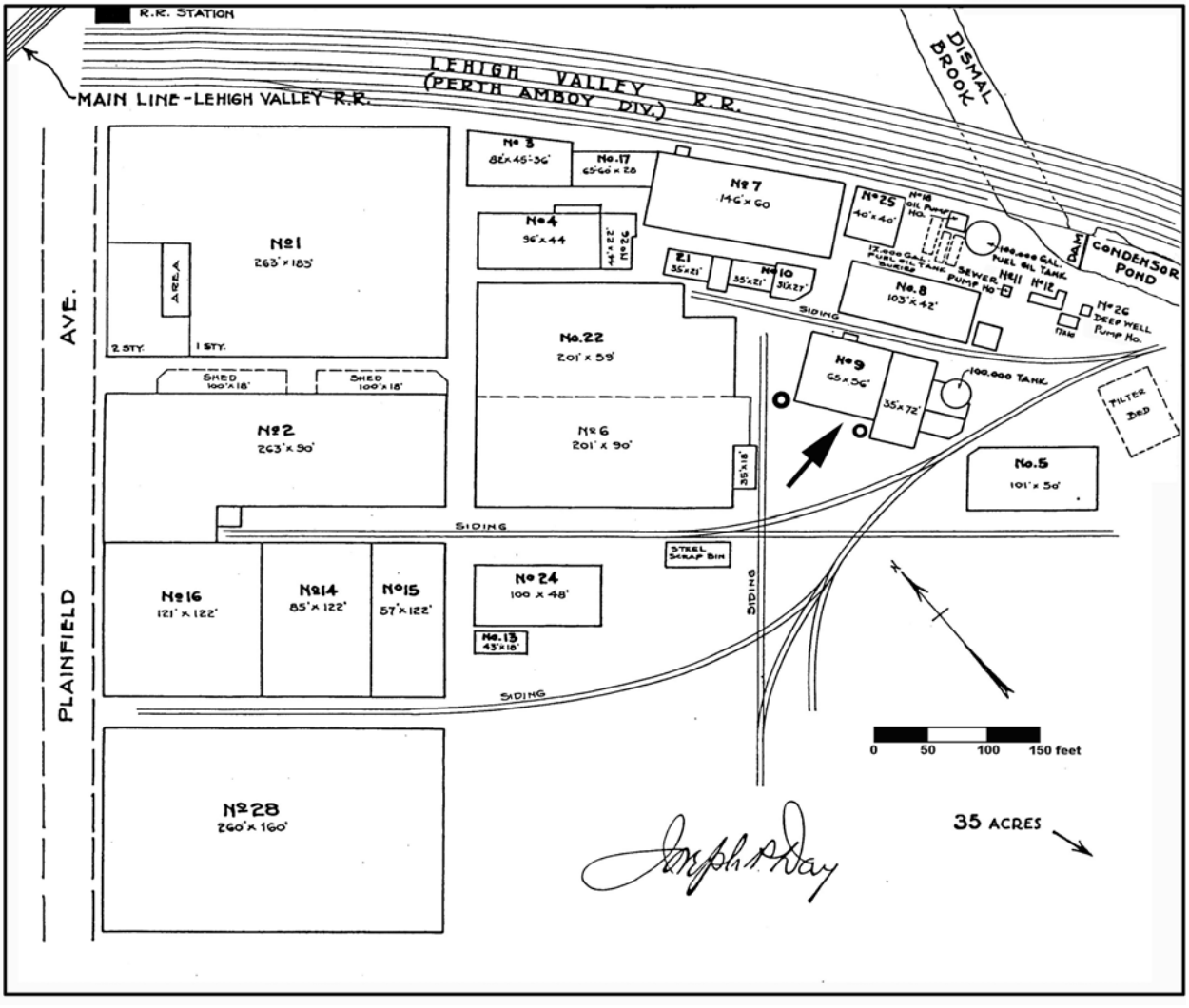

Figure 7. BUILDINGS 9 AND 30 AND 1929 SOUTH PLAINFIELD WORKS
Source: Day 1929

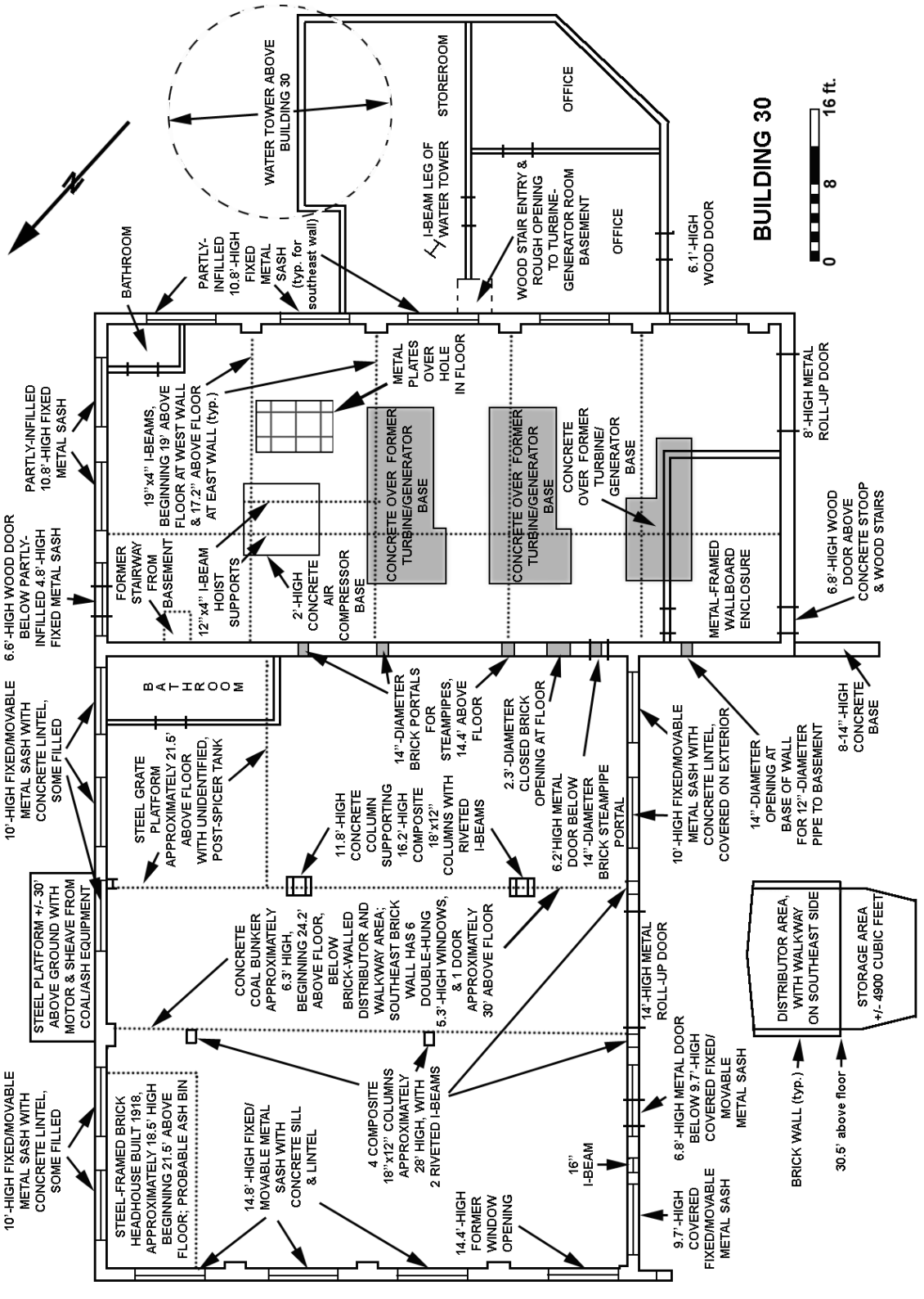

Figure 8. 2007 GROUND FLOOR SKETCH PLAN AND COAL BUNKER CROSS SECTION

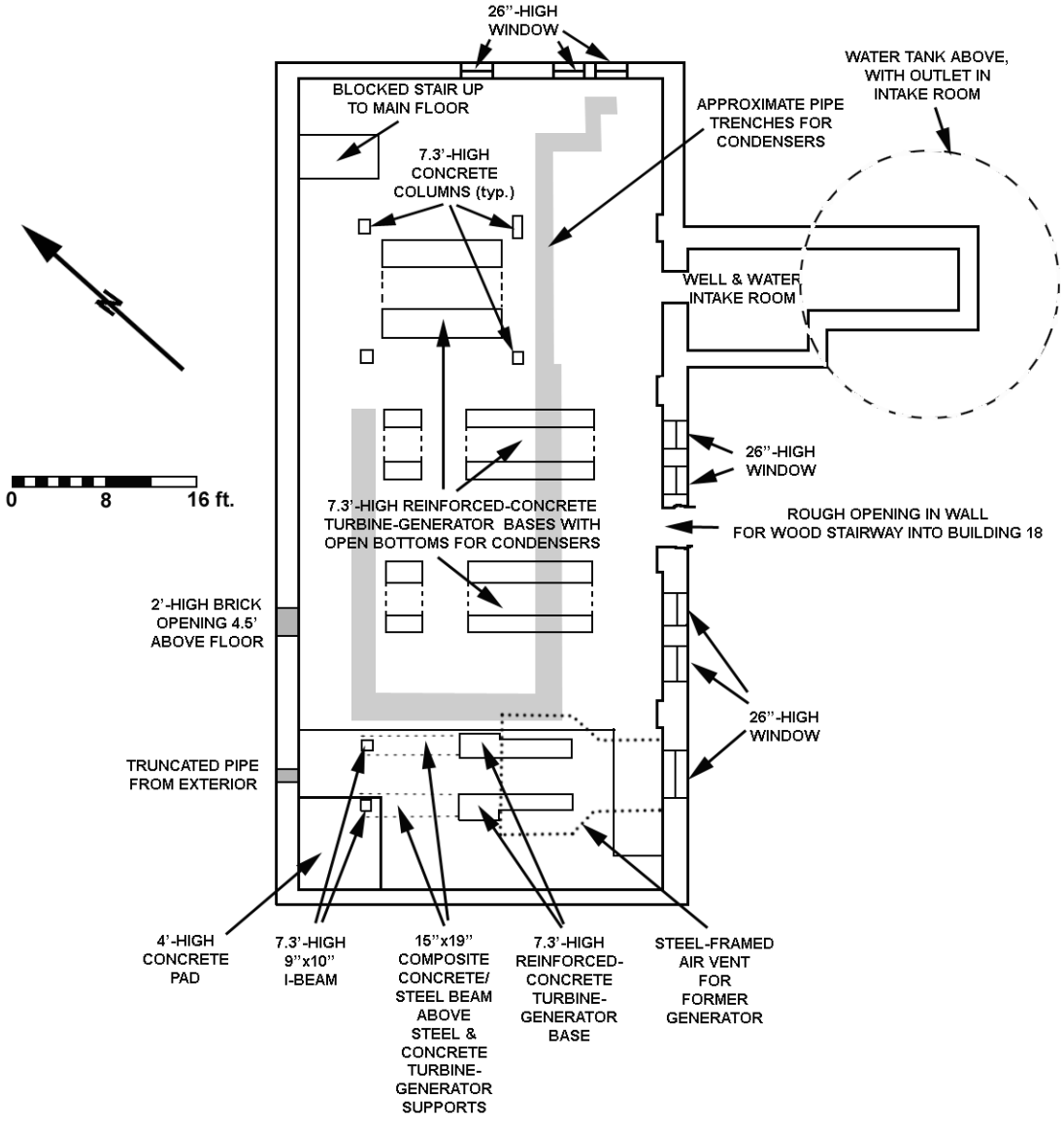

Figure 9. 2007 TURBINE-GENERATOR ROOM BASEMENT SKETCH PLAN

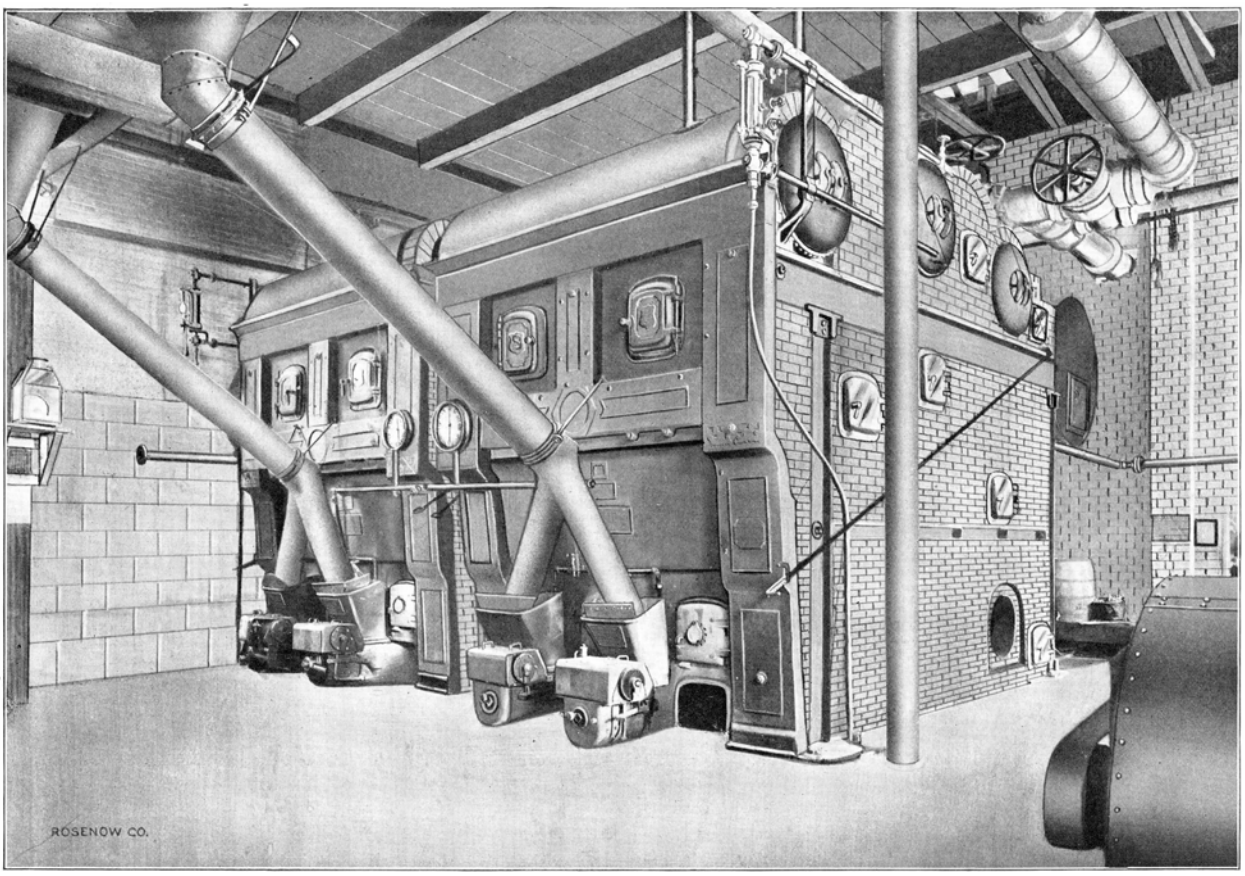

Figure 10. TYPICAL EARLY 20TH-CENTURY STIRLING BOILER
Source: Stirling Consolidated Boiler Company 1906: 194.

The two units pictured, with combined 1450-hp output, were larger than any at the South Plainfield Works but they show gravity coal feed from an overhead bunker to underfeed automatic stokers similar to the equipment installed in South Plainfield in 1918. Steam header at upper right is also similar to inferred arrangements at the South Plainfield Works.

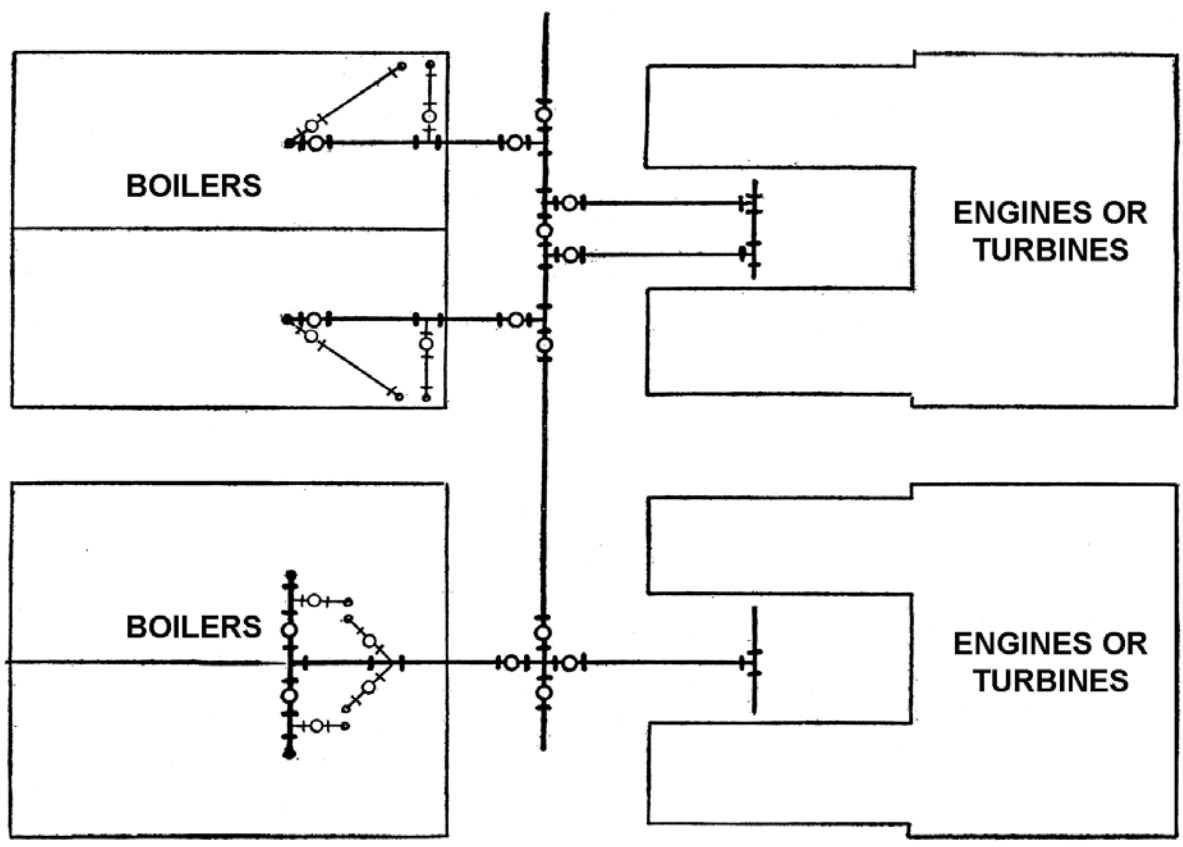

Figure 11. TYPICAL STEAM HEADER PLAN
Source: Koester 1906: 184.

Diagram shows single-header plan; South Plainfield Works powerhouse could instead have had a double- or ring-head plan.