

HAWAIIAN ELECTRIC COMPANY, WAI'AU POWER PLANT, UNIT 1  
& 2 BUILDING  
475 Kamehameha Highway  
Pearl City  
Honolulu County  
Hawaii

HAER HI-120  
*HAER HI-120*

PHOTOGRAPHS  
WRITTEN HISTORICAL AND DESCRIPTIVE DATA  
FIELD RECORDS

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**  
**HAWAIIAN ELECTRIC COMPANY, WAIAU POWER PLANT,**  
**UNIT 1 & 2 BUILDING**

**HAER No. HI-120**

- Location:** 475 Kamehameha Highway  
Pearl City  
Honolulu County, Hawaii
- U.S.G.S. Topographic map, Waipahu, HI 1998 (7.5 minute series)  
Universal Transverse Mercator Coordinates NAD 83:  
04.607590.2365560
- Lat/Long Coordinates:  
21°23'20.5" N  
157°57'43.5" W
- Present Owner:** Hawaiian Electric Company, Inc.
- Present Use:** Vacant
- Significance:** Waiau Power Plant, Unit 1 & 2 Building is significant for its association with the electrical supply system for Oahu. The building was built in 1938 and its generating units came on line in 1938 and 1940. Units 1 & 2 were important additions to the Hawaiian Electric Company's generating capacity, providing power initially to military installations and plantation communities in Central Oahu.
- Historian:** Dee Ruzicka  
Mason Architects, Inc.  
119 Merchant Street, Suite 501  
Honolulu, HI 96813
- Project Information:** This report is produced in advance of the removal of all Unit 1 & 2 electrical generating equipment from the Waiau Power Plant. This includes the boilers, turbines, generators, piping, pumps, and the exterior steel smokestack. The interior of the building will be converted to office space.

## Part I. Historical Information:

### A. Physical History:

1. **Date of construction:** 1938. Building completed and Unit 1 in operation on June 20, 1938. Unit 2 went into operation on August 27, 1940.
2. **Engineer:** Building and power generation systems designed by Hawaiian Electric Co., Inc. The design team for the building was headed by R.J. Thomas, chief engineer of plants, and included engineer and draftsman Louis C. Dewey. Herbert Heinrich was electrical engineer in charge of electrical design and construction.
3. **Builder/ Contractor/ Supplier:** Foundation concrete poured by Hawaiian Contracting Co. Building framework and construction by Hawaiian Electric Co., Inc.
4. **Original plans and construction:** The original building is a large steel frame structure with corrugated asbestos cement panel siding that has a rectangular foot print with approximate dimensions of 155' x 140'. The building is built on a concrete foundation with a concrete main floor. Built on a slightly sloping grade, it is about 63' in height to the roof ridge at the northeast side of the main portion of the building, which houses the boilers, turbines, and generators. The roof of the main portion is twin hipped with a center valley gutter and is sheathed with corrugated metal panels. The hip roof over the northeast section of the main portion of the building is 66'-6" wide and the hip roof over the southwest section is 50'-0" wide. The building has a single-story section about 24' wide along its southwest side, which has a flat roof. Original windows in the building are multi-light (35-light; five lights wide x seven lights high), metal frame, with two, six-light awning sash in each. Two steel smokestacks rose from grade on the northeast side to about 20' above the main roof ridge.
5. **Alterations and additions:** Ca. 1945, when construction on the Unit 3 building was started (that abutted Units 1 & 2 on the southeast side), a concrete party wall was installed to replace Unit 1 & 2's wall of concrete asbestos panels. At the same time, the first two floors of asbestos cement panels on the remaining three walls of Unit 1 & 2, (from grade up to about 40' height) were removed and a cast concrete wall was constructed.<sup>1</sup> New, smaller window openings were built into this concrete wall on the three exterior sides. On the southwest side, a portion of this concrete wall is built lower than the typical 40' height, to about 35' height. In this area, the lower portions of the large 35-light windows at the second floor were removed. Ca. 1946, the approximately 40' long, single-story washroom and locker room area was added at the center of the rear (southwest) side.

The smokestacks were replaced in 1960. The approximately 19'-3" high, tapered base portions of riveted steel plate on each stack were retained, but the original riveted upper vertical portions (approximately 58' high atop the tapered base) were removed and replaced with welded steel sections that were about 84' high atop the tapered base. Sometime after this 1960 replacement, the extant Unit 1 stack was shortened to its present height of about 60'. Sometime after the December 31, 1982 decommissioning of Units 1 & 2, the Unit 2 stack was removed. After the 1982 decommissioning, the former electrical bay portion of the building (northwest side) was converted to office space. A large-scale exterior door opening on the northeast side was partially filled with concrete

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<sup>1</sup> HECO photo archives, photo "Waiiau 1+2, Archive 1 – 001", in folder Waiiau Archives folder 1. Ca. 1945.

block and a double flush door with vision panes added for entry to the added office area. Original windows in this office portion of the building have been replaced with aluminum sliding sash and fixed sash. All original exterior doors have been replaced with flush doors, some with vision panels. A large scale doorway on the northwest side has a replacement roll up door.

## **B. Historical Context:**

### Electric Power on Oahu and the Hawaiian Electric Company, Inc.

Electric power in Hawaii dates from the late 1880s. In 1886, a demonstration of fifty electric lights was shown at Iolani Palace in Honolulu and in 1888 the Hawaiian government began lighting Honolulu streets and supplying some private residences using hydroelectric power from Nuuanu Stream. Electric power from here was often interrupted because the water flow that produced electricity was sporadic. By 1890, the Honolulu firm of E. O. Hall was installing small power plants at residential locations and supplying some businesses with power via wiring strung from a steam dynamo<sup>2</sup> at their building in downtown Honolulu. On May 7, 1891 several E. O. Hall corporate officers, under the direction of Jonathan Austin, filed with the Hawaiian government to form a partnership to produce and supply electricity as the Hawaiian Electric Company (HECO). On October 13, 1891 the business was incorporated.

On January 12, 1893, as one of her last official accomplishments, Hawaiian Queen Liliuokalani approved legislation that empowered the government to provide and regulate the production of electricity in Honolulu. Her monarchy was overthrown five days later. On May 3 HECO (the only bidder) was granted a 10-year franchise by the provisional Hawaiian Government to supply electricity to anyone in Honolulu. The government retained control of the operation at Nuuanu and maintained it to operate streetlights when it was able. The following year HECO began operating from a generator plant containing two, 45kw dynamos near the corner of Alakea and Halekauwila Streets in Honolulu.

By 1906 HECO power lines extended to Waikiki and Manoa Valley, reaching over 2,500 customers. In 1908 a 750kw steam turbine was installed at Alakea Street, and in 1910 and 1913 1,500kw and 2,500kw units were brought on line. In 1916 substations fed by high voltage transmission lines came into use and began to replace the older system of low voltage distribution lines. By this time HECO provided power to windward Oahu and to Pearl Harbor. Additional property adjacent to the Alakea Street site was purchased in 1918 and in 1920, HECO opened a new facility there which filled the entire block bounded by Alakea, Halekauwila, Bishop, and Allen Streets. This plant had a 10,000kw unit that was upgraded in 1922 with a second unit of the same capacity, providing service to Kahuku, Waialua and Ewa. Ca. 1924 another 10,000kw unit was added and in 1930 a new power plant building was built adjacent that housed a 20,000kw steam turbine.

In 1933 a high pressure boiler was added to the Alakea Street plant in Honolulu that supplied 650 psi steam to a new 10,000kw topping turbine. This is a turbine designed to operate with input steam at a much higher pressure than earlier types. The topping turbine would then exhaust its steam at a lower pressure and it would then be used to feed the existing turbines already in use in the power plant. The exhausted 250 psi steam from the 1933 topping turbine was fed into HECO Honolulu Units 1, 2, and 3 which were installed in 1913, 1920, and 1922.

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<sup>2</sup> A dynamo is an early type of electrical generator using rotating coils of wire to produce direct current. Generators that produced alternating current replaced them.

Construction on the Waiau Power Plant began on June 3, 1937. It was HECO's second power plant, after the existing Honolulu plant at Alakea Street. The Waiau Power Plant building was finished in June 1938. It initially contained a 7,500 steam turbine generator that was designated Unit 1. A second turbine of 15,000kw capacity was installed in 1940. This was designated Unit 2. Most of the 22,500kw power production of Waiau Power Plant Units 1 & 2 was used by military installations and plantation communities in central Oahu.<sup>3</sup>

On the morning of December 7, 1941 when the Japanese attacked Pearl Harbor, Waiau Power Plant was hit by machine gun fire from the Japanese aircraft. No appreciable damage was sustained. "The bullets went through the plant but too high to do any damage to either the machinery or the operating crew."<sup>4</sup> The HECO employees on duty at Waiau Power Plant that morning shut down and then restarted the plant three times, as waves of attacking planes flew overhead. The shut downs were undertaken to minimize damage that hits would inflict on pressurized equipment. During lulls, it was assumed the attack was over and the equipment was powered back up to provide power for recovery efforts. Concussions from explosions tripped pump switches open and employees resorted to manual switching to keep pumps operating.<sup>5</sup>

During World War II, HECO provided vital electric power to the military for the war effort, sometimes blacking out residential service to be able to meet military demands. More often, coordination between government and private sector resulted in altered work schedules to allow HECO's power to flow to the military when they needed it.

In 1944, the Alakea Street plant received a new 42,000kw unit, and in 1946 a new, 50,000kw unit was built at Waiau. A new 116,000kw power plant was built adjacent to the Alakea Street plant in 1954.

A third power plant location was built in 1963 at Kahe Point in Leeward Oahu with a generating capacity of 86,000kw. In late 1964, Kahe Point received a second 86,000kw unit. Both units were reheat steam turbine type systems. The Kahe Point site was originally considered for a nuclear power plant, but in the early 1960s nuclear plants of the small size that HECO needed were not available in the United States.<sup>6</sup> Kahe Point would become the main power generating station for HECO, with six turbines supplying a total of 648,000kw in the early 1990s.

As a result of damage from Hurricane Iwa in November 1982, ninety seven percent of HECO customers were without power as transmission lines were put out of service and operators shut down systems to prevent generator overload. The only area of Oahu to maintain power service throughout the hurricane was an area of Pearl City adjacent to the Waiau Power Plant.

On December 31, 1982 Waiau Power Plant Units 1 & 2 were retired from service.

### Waiau Power Plant Units 1 & 2

The Waiau Power Plant was planned in 1936 when HECO Board of Directors authorized the construction of an additional power plant near Pearl Harbor to augment its existing generating facilities at the Honolulu waterfront. The new plant was to "take care of the rapidly increasing

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<sup>3</sup> Carl Myatt, *Hawaii The Electric Century, A Special Edition for Hawaiian Electric Company* (Honolulu: Signature Publishing). 1991. p. 151.

<sup>4</sup> Ibid. p. 152.

<sup>5</sup> Ibid. p. 153.

<sup>6</sup> Ibid. p. 164.

load and to provide a greater factor of safety in service to the territory west of [the] Iwilei Substation."<sup>7</sup> The military, plantations, and canneries were the primary uses that prompted the construction of additional generating facilities at Waiau.<sup>8</sup> HECO engineering staff designed the plant on about 8 acres of land that was purchased at the Waiau site. Construction of the building foundation began on June 3, 1937 by Hawaiian Contracting Co. The design of the building allowed for the installation of two generating units. The first (Unit 1), a 7,500kw Westinghouse turbine generator and a high-pressure Babcock & Wilcox Co. boiler to supply it with steam, was installed and running in the completed building on June 20, 1938. The boiler was designed to supply 90,000 lbs of steam at 650 psi and 825°f. The boiler was vented to a steel smokestack on the northeast side of the building.

For coolant, the Waiau Power Plant was designed to utilize a flow of fresh water from a nearby artesian well. The plant could also operate using salt water for cooling that was taken from Pearl Harbor.<sup>9</sup> This flow of fresh water, along with the easy availability of fuel oil delivery from tankers entering Pearl Harbor, and Waiau's proximity to the military and rural users of its power were factors in selecting the site.<sup>10</sup>

In conjunction with Waiau Unit 1, a switching station and transformer bank were installed with a nine mile long, 44,000 volt transmission line from it to the HECO substation at Iwilei. This line linked the new Unit 1 at Waiau with the existing generating facility at downtown Honolulu, and to Oahu's existing electrical system.

In late 1938, after only a short time of operation of Unit 1 at Waiau, HECO outlined plans for the addition of a second generating unit there. HECO stated that "even with the completion of [Unit 1] at Waiau and its connecting lines and substations, the necessity for greater capacity and standby and for facilities to ensure reliability of service in an expanding system shows no diminution for the immediate future."<sup>11</sup> The installation of a second generating unit to the Waiau facility was seen as the most feasible and economical option.

This second unit had been anticipated as early as the 1936 design of the Waiau facility, which provided for a second unit in the building and for the expansion of additional units in a future adjacent structure. Design work for Waiau Unit 2 installation went forward in 1939 and construction started in September. By the end of the year the necessary foundation work for boiler and turbine was completed and the equipment was installed in the first half of 1940. Unit 2 was a 15,000kw turbine generator with a maximum capacity of 18,750kw. Steam was supplied by a fuel oil burning, high-pressure boiler (190,000 lbs of steam per hour at 650 psi and 850°f) that was vented into its own dedicated stack, identical and adjacent to the Unit 1 stack. The steam condenser of the new unit had 14,000 square feet of surface and was designed to produce 28½ inches of vacuum. Unit 2 was put into operation on August 27, 1940. In addition to Unit 2, the 1939-40 work at Waiau included enlarging the substation there and the installation of another 44,000 volt transmission line to the downtown Honolulu facility.<sup>12</sup> The Waiau substation enlargement replaced the four 2,500 Kva transformers (that were installed in

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<sup>7</sup> HECO, "Annual Reports, Hawaiian Electric Co., Inc." 1936. p. 8.

<sup>8</sup> "Waiau Plant Takes Form," *The Load Builder*, March 1938. p. 1.

<sup>9</sup> *Ibid.* p. 1.

<sup>10</sup> "Waiau Plant Completed," *The Load Builder*, August 1938. p. 1.

<sup>11</sup> HECO, "Annual Reports, Hawaiian Electric Co., Inc." 1939. p. 7.

<sup>12</sup> *Ibid.* p. 7.

conjunction with Unit 1) with seven 5,000 KvA 11,000-44,000 volt transformers to provide a capacity margin for incoming and outgoing transmission circuits.<sup>13</sup>

In 1940 HECO also purchased over 8 acres of additional land at Waiiau from the Territory of Hawaii, which brought the total there to almost 17 acres. HECO erected ten wooden dwellings on a portion of this land for employee housing, citing the advantages of having Waiiau employees near the plant in the event of a power emergency in Honolulu.<sup>14</sup> This housing area was called Honokawailani Place and it was located south of the present 138 Kv switching station. The housing area existed until at least the 1950s. Construction of Waiiau Outdoor Unit 5 in 1959 would have impinged on it.

#### Later Additions at Waiiau Power Plant

During World War II, electric power use on Oahu climbed, with the military and a growing population placing demand on HECO to expand its production. In 1944, they constructed a 35,000kw generating unit at the downtown Honolulu plant. During that year, HECO determined that within five to eight years an additional 80,000kw would be needed. HECO decided that this additional generation capacity would come in two phases of 40,000kw each at the Waiiau Power Plant.<sup>15</sup> Construction of the new, approximately 100' high building to house the generating units, which would become Waiiau Units 3 & 4, was begun in mid 1945 with grading and site preparation. This new building abutted the southeast side of the Unit 1 & 2 Building. By early autumn 1946 two large fuel oil tanks were erected near the new building site, the building shell for Unit 3 was completed, and installation of the boiler and turbine foundation for it was underway.

A shortage of building materials was a persistent problem on Oahu after World War II, and this slowed the pace of construction at Waiiau. In the interim while Unit 3 was under construction, HECO leased a former US Navy floating power barge, YFP-1 *Jacona*, to provide power to the Oahu grid. Fitted with fuel oil-fired boilers and turbines to provide up to 20,000kw, the *Jacona* was moored offshore of Waiiau from March 1946, supplying electrical power. Unit 3, a 40,000kw generator in a tall, five-bay building, was completed in December 1947.

Planning for Waiiau Unit 4, identical to Unit 3, began almost immediately after Unit 3 was brought on line. Construction of Unit 4 began in early 1949. HECO put up a three bay addition on the southeast side of the Unit 3 building to house it. When completed, these two sections, housing Unit 3 & 4, formed one eight bay building. By the end of 1949 the building shell and turbine foundation were built and boiler installation was underway. The 40,000kw Unit 4 was brought on line in November 1950.

In late 1959, outdoor generating Unit 5 was brought on line at a location about 140' east of the Unit 3 & 4 Building. In August 1961 it was joined by outdoor Unit 6, in the same structure.

On December 1, 1966 outdoor generating Unit 7 became operational in a structure about 160' east of Units 5 & 6. On December 1, 1968 it was joined by Unit 8 in the same structure.

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<sup>13</sup> Ibid. p. 10.

<sup>14</sup> HECO, "Annual Reports, Hawaiian Electric Co., Inc." 1940. pp. 9-10.

<sup>15</sup> "Progress Being Made at New H.E.Co. Power Plant," news clipping from HECO archives. Ca. September 1946.

## Part II. Structural/ Design Information:

### A. General Statement:

- 1. Character:** Utilitarian power plant design, three stories. The main part of the building has a dual hip roof with narrow overhanging eaves and fairly large multi-light windows high on the walls that help illuminate the upper areas of the large interior power generating space. The cast concrete main floor of the building provides solid anchoring for the heavy boilers, generating turbines and their associated pumps, large diameter piping, and heavy equipment. The upper part of the building is sheathed in corrugated siding and the interior above the turbine deck is a tall, open and airy space, which helped to dissipate residual heat from the boilers. At the rear (southwest side), the building has an approximately 24' wide single story section of concrete construction with a flat roof that runs the length (about 155') of the building. This section has battered concrete buttresses at its corners and at points along its length.
- 2. Condition of Fabric:** Good.

### B. Description: Exterior and Structural.

- 1. Overall Dimensions:** The power plant has a rectangular footprint of about 155' x 140'. At the rear (southwest side), the approximately 24' wide, single story section has a height to the cornice of about 24' with a center section along its approximate 155' length that has a lower height of about 12' at the cornice. The main section of the building (footprint about 155' x 116'-8") is much taller, about 55' height to the eaves and about 63' to the ridge of the dual hipped roof.
- 2. Foundations:** Concrete footings and concrete slab-on-grade. The concrete support pedestals for the turbines (four per turbine) are massive, typically 4' to 5' thick and from about 7' to 12' long. These extend up about 20' from the concrete main floor to the turbine deck.
- 3. Walls:** Cast concrete on the lower portions up to about 40' height. This includes the 24' wide, single story section at the rear. The remainder of the wall above most of the 24' wide section has concrete only up to about 30' height. Horizontal marks from the boards used in forming the concrete are visible in most areas. Water table is concrete, typically about 4' high with a 6" high, 8" wide ledge. Above the concrete walls, the building is sheathed in vertically oriented corrugated asbestos cement panels ½" thick, with 4" wide corrugations.

4. **Structural system, framing:** Steel I beam post and girder framing. The open, main portion of the building has large framing posts of paired, nested 12" I beams on 3'-0" high concrete bases at 20'-0" spacing along the length of the building. A line of these nested I beam framing posts is present under the valley between the hip roofs. Secondary framing posts are 10" steel I beam.
5. **Porches, stoops, balconies, bulkheads:** Cast concrete double-run stairs with steel pipe railings at the washroom doorways at the southwest (rear) side.
6. **Chimneys/stacks:** One painted steel stack at the northeast side about 4' from the building wall that formerly served Unit 1. The stack has a riveted steel plate lower section about 19' high that tapers from about 10' diameter at the bottom to about 6'-6" diameter at the top. Above this is a welded steel plate vertical section about 6'-6" in diameter that extends up to about 5' above the eaves of the hipped roof. This stack is set on a concrete foundation that originally supported both stacks. The foundation footprint is about 14' x 25' and it projects about 6' above grade. The northwest side wall of the foundation is fitted with a small metal door that provided clean out access beneath the Unit 1 stack.
7. **Openings:**
  - a. **Doorways and doors:** The northwest side has a large-scale doorway leading into the main generating space. This doorway has a roll up door that appear fixed in the open position. Another large-scale doorway with a (closed) roll up door is located at the east end of the northeast side. Human scale doorways in the building are flush metal or flush with vision panels.
  - b. **Windows and shutters:** Original windows at the northeast and southwest sides are multi-light, steel sash, with awning sections. These have obscure glass, wired lights. These large upper windows are thirty five light (five light across and seven rows) with two, six-light awning sections. Windows in the renovated office section at the northwest side are aluminum sliding sash, some with fixed upper lights. At the single story section at the rear, window openings are added fixed lights or fixed horizontal louvers.
8. **Roof:**
  - a. **Shape, truss, type, covering:** The main portion of the building has a roof of two hipped sections, one at the front (northwest side, above the boiler section) is 66'-8" wide and the other at the rear (southwest side, above the turbine section) is 55'-0" wide. Both hip roofs span the approximate 155' length of the building. Both are supported by trusses that have sub diagonals radiating outward from a central point. The roof is sheathed with corrugated asbestos cement panels. An added covering of roll roofing (appearing to be rubber membrane) has been applied on the slopes of both roof sections that face the longitudinal valley gutter between the sections.

- b. **Cornice, eaves:** The eaves are open, showing the underside of the corrugated sheathing, and have a narrow overhang of about 2'.
- c. **Dormers, cupolas, towers, clerestories, monitors:** The ridge of each hipped section of the roof has five circular vents.

**C. Description:** Interior.

1. **Floor plans:** The power plant building is primarily a large space for the boilers, turbines, generators and other associated equipment for producing electricity. At the northwest side of this main space is a full height portion of the building (former electric bay) that is now three floors of office space, separated from the main space by an added concrete wall. The large roll up door on the northwest side that gives access from the exterior to the main space forms a passageway through the first floor of this office area. At the southwest side of the main space is a single-story section that contains additional office space that is connected to the three-story office area. This single-story section also contains a circulating pump room and an oil storage room that are accessed from the main space, and washrooms that are accessed from the building exterior, rear side. The main space has a second floor, called the turbine deck, which is accessed from stairs up from the main floor. The main floor is multi-level. The northwest portion at the boilers is elevated about 5' above the southwest portion that has the Unit 1 turbine and generator support structures. Unit 2 turbine and generator support structures are on a portion of the main floor that is about 3' below the floor level at the Unit 1 support structures. This (Unit 2 turbine support) level of the main floor also has the circulating pump room and oil storage room. Another large piece of equipment, the condenser for each turbine, is located on the main floor, beneath its respective turbine and between each Unit's turbine support structures.

At the upper level, the turbine deck flooring is mostly comprised of perforated metal grating and provides a work floor around the turbines and generators, which are supported at this level by their concrete support structures. The turbine deck also extends around the boilers. Near the northwest passageway an area of turbine deck is omitted, allowing a full-height interior at this area. A 40-ton gantry crane runs longitudinally on rails at about the level of the buildings eaves. At this full height area, it can lift items from the main floor up to the turbine deck.

2. **Work flow:** The main generating space has numerous stairways between the levels of the main floor and a central stairway between the main floor and the turbine deck. This allows efficient access between all areas and to all the equipment. Boilers that begin the process of generating electricity are tall, and are accessed at the main floor. Steam generated at the boilers is piped to turbines and generators at turbine deck level, then cooled and condensed at the main floor after it exits the turbines. Cooling water for this process is brought into the plant by large pumps on the main floor. Condensed water is fed back to the boilers to become steam again and repeat the process and the warmed cooling water is discharged into Pearl Harbor.

3. **Stairways:** Stairways in the main space, between the main floor levels and from the main floor to the turbine deck, are perforated metal grating with metal pipe handrails.
4. **Flooring:** The main floor is concrete, mostly with a bare finish that has been burnished by years of use, oil, and water. Some areas are painted with stripes and markings denoting specific areas, aisles, and places to keep clear. The turbine deck is mostly perforated metal grating. A portion of the turbine deck floor about 15' wide at the southwest side, is concrete.
5. **Wall and ceiling finish:** Walls are painted concrete, typically showing the horizontal impressions of the boards used in their forming. Upper wall finishes are the painted inside surface of the corrugated asbestos cement panels. The ceiling is the painted underside of the corrugated asbestos cement panels of the roof sheathing. The three-story office portion is typically painted gypsum board walls, with some areas of painted concrete block. These offices and halls have either carpeting or vinyl floor covering and dropped acoustic tile ceilings.
6. **Openings:**
  - a. **Doorways and doors:** Interior doorways have a combination of flush doors and flush doors with vision panels. A roll up door separates the oil storage room from the main generating space. A human scale flush door in the southeast wall provides access from the main generating space into the adjacent Unit 3 & 4 Building. It is accessed by a metal grate stairway leading up from the turbine deck, south corner.
  - b. **Windows:** The awning window portions of the upper windows are operated by a horizontal shaft that links them together. The shaft is chain-drive rotated from the turbine deck. The shaft operates a pinion gear that advances an arched rack attached to the awning sash, thus opening and closing each window.
7. **Mechanical equipment:**
  - a. **Heating, air conditioning, ventilation:** The building is not heated. The office area is air conditioned and the main generating space was designed to utilize natural ventilation from the open passageway, original awning windows at three floors, and roof vents.
  - b. **Lighting:** The main generating space has industrial type pendant incandescent fixtures, typically with enameled metal shades. The office area has either recessed or pendant fluorescent lighting. Washrooms at the single-story section have pendant incandescent fixtures.
  - c. **Plumbing:** Washrooms have typical plumbing. Most fixtures in the main portion of the building and at the single story section appear original.

**D. Machines:** Boilers at both units were manufactured by Babcock & Wilcox, and the majority of the rest of the equipment for both units was supplied by the Westinghouse Co. The following major equipment is extant.

Unit 1

Item	Manufacturer	Notes	Serial No.
Boiler, F-106	Babcock & Wilcox	90,000 Lb/hour, F-type boiler, size 22	
Turbine	Westinghouse	3600 rpm	1-A6821-1
Generator	Westinghouse	7,500kw	
Condenser	Westinghouse	1665 sq. ft.	1-A6823-1
Evaporator	Westinghouse	100 tubes	1-A6819-1
Circulating water pump #11, axial pump	Westinghouse	16", 870rpm	1-A6924-1
Circulating water pump #12, axial pump	Westinghouse	16", 870 rpm	1-A6924-2
Condensate pump #11	Westinghouse	w/ 15Hp motor	
Condensate pump #12	Westinghouse	w/ 15Hp motor	

Unit 2

Item	Manufacturer	Notes	Serial No.
Boiler, F-210	Babcock & Wilcos	F-type boiler, size F-25	
Turbine	Westinghouse	No ID plate on turbine	
Generator, type SK DC	Westinghouse	Style 8P859, 15,000kw	1-8P859
Condenser	Westinghouse	14,000 sq. ft.	
Evaporator	Westinghouse	61 sq. ft.	1-A8576-1
Circulating water pump #21, axial pump	Westinghouse	20", 690 rpm	1-A8512-1
Circulating water pump #22, axial pump	Westinghouse	20", 690 rpm	1-A8512-2
Condensate pump #21	Westinghouse	1160 rpm	1-A8511-1
Condensate pump #22	Westinghouse	1160 rpm	1-A8511-2

**E. Site Layout:** The location of the site, on the shore of Pearl Harbor, is an important consideration, due to the cooling water requirements of a steam-turbine type generating plant. Although the steam system is essentially a closed system and uses distilled water, the cooling system that condenses this steam after it is run through the turbines was designed to use fresh or salt water at this plant.<sup>16</sup> When this site was selected for the plant, ca. 1936, a consideration was the associated artesian well, located just west of the building. This well flowed into the existing small pond and from there into Pearl Harbor via a small channel running south. With the artesian well flowing into the pond, and the pond connected to Pearl Harbor, drawing water from the pond could utilize the artesian flow that would otherwise flow out unused. Or, if the

<sup>16</sup> "Waiau Plant Takes Form," *The Load Builder*, March 1938. p. 1.

well was plugged or diverted, the pond would still hold Pearl Harbor water that could be pumped off for cooling use. This artesian well is Oahu well #199, drilled in 1910 to a depth of about 300'. Before HECO obtained the property, the well was owned by the Territory of Hawaii and the Sing Chong Company and was used for domestic purposes.<sup>17</sup> Many artesian wells were sealed after World War II, it is not known if this well is still flowing or is sealed.

### **Part III. Operations and Process:**

**A. Operations:** The boilers at Waiau Unit 1 & 2 were fired with fuel oil stored in nearby tanks. The steam thus produced stays in a closed system that cycles distilled water through each boiler. Live steam is piped from the boiler to spin the turbine, which rotates the generator and produces electricity. The power generated was sent to the switches and breakers in the electrical bay section of the building, which sent the power out to the main distribution center at the downtown Honolulu plant, or to Iwilei or other substations on Oahu as needed. Electric power cannot be stored, it must be created as demanded, so oftentimes boilers and turbines are kept operating under limited power so they can be brought on line quickly if demand rises. When the distilled water steam has done its work in the turbine, it is sent to the condenser, which transforms it back to water that is returned to the boiler to be heated again into pressurized steam. This system, although closed, does need replenishment with distilled water. To accomplish this, an evaporator between boiler and turbine utilizes heat from the steam to distill water. Distilled water is stored in a tank and added to the boiler supply water as needed.

A separate system circulates cooling water through the condensers to transform the distilled water steam back into water for reuse in the boilers. This cooling system draws water from the small pond west of Unit 1 & 2 that is connected by a channel to Pearl Harbor. This cooling water is drawn through a screen in the pond to remove debris, pumped via the large circulating pumps on the main floor of the generating space and sent to the condensers. Cooling water leaving the condensers is discharged back into Pearl Harbor. Originally, an artesian well supplied fresh water to the pond, but it is not known if the well still flows.

**B. Technology:** Steam turbine generation of electricity was not a new technology on Oahu in 1938, having been used for the previous thirty years there. During that time, HECO generating capacity climbed as the associated turbines and boilers got more powerful. By the time of the installation of Waiau Unit 1 & 2, it was the primary method of generating power.

**C. Workers:** Some Waiau Unit 1 & 2 workers lived in company (HECO)-provided housing adjacent to the plant, beginning in 1940. At a time when travel to Waiau from Honolulu was time consuming, this served to provide the company with workers who could quickly man the generating station in times of emergency. This housing area is no longer extant, probably removed upon the construction of Waiau Outdoor Unit 5 in 1959.

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<sup>17</sup> H. T. Stearns and K. N. Vaksvik, *Records of the Drilled Wells on Oahu, Hawaii, Bulletin 4*. (Honolulu: Territory of Hawaii, Division of Hydrography). 1938. p. 138.

**D. End Product:** The product of Waiau Power Plant Units 1 & 2 was electrical power, capacity 22,500kw when both units were completed in 1940. HECO routed this electrical power to the switching station at downtown Honolulu for distribution or it was sent out directly to various substations as needed. Waiau Power Plant Units 1 & 2 were taken out of service on December 31, 1982.

#### **Part IV. Sources of Information:**

##### **A. Architectural Drawings and Early Views:**

Original drawings for Waiau Power Plant Units 1 & 2 were produced by the Hawaiian Electric Company, LTD, between April 1937 and September 1939. They are stored in HECO archives.

Early photographs of Units 1 & 2 (1937-1962) are also stored in HECO photo archives, Folders;

Waiau Archives – Folder 1

Waiau Archives – Folder 2

Waiau PR – Folder 1

Waiau PR – Folder 2

Additional photographs; Aerial photos taken 1939-1941 are available at the Hawaii State Archives. Folder PPA-59-2, photos:

M59.35

M59.37

M59.45

##### **B. Bibliography:**

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"H.E. Co. Ready to Build Plant." March 22, 1937. p. 2.

"H.E. Plans New Kaimuki Lines." August 18, 1937. p. 7.

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Oneida Total Integrated Enterprises (OTIE). "Hawaiian Electric Company, Inc. Units 1 and 2 Equipment Removal Project." Project drawings for the 2014 alteration of the building to office space. October 30, 2013.

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**C. Likely Sources Not Yet Investigated:**

Bishop Museum, Honolulu, photo archives.

HAWAIIAN ELECTRIC COMPANY, WAIAU POWER PLANT,  
UNIT 1 & 2 BUILDING  
HAER No. HI-120  
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Location Map (base map source: USGS Waipahu, HI 1998 quadrangle)

