LIHUE PLANTATION COMPANY, SUGAR MILL BUILDING
Haleko Road
Lihue
Kauai County
Hawaii

HAER HI-82
HI-82

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

LIHUE PLANTATION COMPANY SUGAR MILL BUILDING

HAER No. HI-82

Location:	Haleko Road Lihue County of Kauai Hawaii USGS 7.5 minute series topographic map, Lihue, HI 1983 Universal Transverse Mercator (UTM) coordinates: 04.458260.2431460
Date of Construction:	1935
Engineers & Builders:	Lihue Plantation
Present Owner:	Lihue MS LLC
Present Occupant:	Vacant
Present Use:	Abandoned
Significance:	The Lihue Plantation Company Sugar Mill is associated with the development and history of sugar in Hawaii. It is a good example of a twentieth century sugar mill in Hawaii, which reflects its period in its machinery, materials, method of construction, and design.
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Date:	October 2008

HISTORICAL CONTEXT

Sugar in Hawaii

Although the growing of sugar cane in Hawaii has a long history, dating back to the period of early migration when Polynesians introduced sugar cane to the islands, Hawaii arrived late upon the world scene for the commercial production of sugar. The earliest known attempt to mill sugar in Hawaii was undertaken in 1802, by a Chinese man on Lanai whose name has been lost to the annals of time. His endeavor was short lived, as were a number of other early nineteenth century efforts. The first venture to establish itself on a long term basis was Ladd & Company at Koloa on the island of Kauai, which commenced operations in 1835. However, by the time Ladd & Company exported its first two tons of raw sugar in 1837, the sugar industry already had been established in the West Indies and South America for over a century, and Cuba alone was producing more than one hundred thousand tons of raw sugar a year. By 1850 world production of cane sugar approached one million tons, and France and Germany were beginning to produce beet sugar.

Despite Hawaii's late entry into sugar's global market place, entrepreneurs were encouraged by the moderate success of Ladd & Company and in the ensuing years several other plantations were started. These operations were relatively small, autonomous operations. The nascent industry was bolstered momentarily during the Civil War by increased demands resulting from the Union being cut off from the south's supply. However, with the conclusion of the Civil War, Hawaii's sugar industry struggled to survive. In 1872 there were thirty-two plantations in existence, but four years later there were only twenty-six, and the industry did not gain a firm economic footing in Hawaii until the passage of the Reciprocity Treaty in 1876, which allowed Hawaii sugar to enter the United States duty free. This exemption gave Hawaii sugar producers an additional profit of two cents a pound. In 1875 Hawaii produced 11,154 tons of cane sugar, less than one percent of the world's output; a dozen years after the signing of the treaty, the islands exported 100,000 tons of sugar. By 1898, this tonnage had risen to 200,667, or over seven percent of the global supply.

Although not the largest producer of sugar in the world, by 1897 Hawaii was the most efficient producer in the world, with an average yield of over four tons per acre, as compared to its chief competitors, Cuba at two tons per acre and Louisiana at one ton per acre. By the 1970s Hawaii's plantations averaged over ten tons per acre. Much of this improvement came from fertilization, pest and disease control, efficient irrigation, more efficient mills and machinery, and richer varieties of sugar cane. A doubling in the use of fertilizer between 1914 and 1924, coupled with the introduction of H-109, a sucrose rich variety of cane developed in Hawaii, led to a dramatic expansion of sugar production during the 1920s when cane tonnage increased seventy-five percent

throughout the islands. By 1930 Hawaii's annual production grew to one million tons, and for the next fifty-eight years met or exceeded that level, before dropping below it in 1988. However, despite producing over one million tons of sugar a year, Hawaii's sugar production began to decline in 1968, which became an irreversible trend. Finding themselves unable to compete in the global economy, one company after another closed its doors. With the September 2008 announcement that Gay & Robinson on Kauai will soon discontinue to grow sugar as food, only one sugar mill, Alexander & Baldwin's Hawaii Commercial and Sugar Company at Puunene on Maui will remain in operation in the islands.

Between 1860 and 1940 sugar was the economic mainstay of Hawaii's economy, which, in turn, profoundly affected the islands' internal politics and overseas relations. Also, with two thirds of Hawaii's land under its control, the sugar industry greatly affected land ownership, distribution of water, and the physical development of the islands. It was also instrumental in Hawaii's population growth and composition, as between 1876 and 1900, Hawaii's population jumped from slightly under 54,000 to over 154,000. During this period workers were imported from China, Portugal, Russia, Norway, and Japan to work in the cane fields. After the turn of the century Puerto Ricans, Koreans, and Filipinos further diversified the islands' work force and added to the foundation on which the islands' present multi-cultural society is based.

The Sugar Making Process at Lihue Plantation Mill

The critical technology for processing cane sugar was developed over the course of the nineteenth century, and since the 1920s there have been no radical innovations in the milling of cane. Thus, the manner in which sugar was processed at Lihue Plantation Company's sugar mill remained constant over much of the twentieth century, and much of the machinery and apparatus present in the mill maintained a long continuity of use, well reflecting the industry standards.

Once harvested, sugar cane must be processed within eight hours, otherwise it starts to ferment. Sugar cane arrived from the fields to the Lihue Mill by train, mixed with dirt, rocks, trash, and scrap metal, which needed to be removed before the cane could be processed. At the mill it was unloaded and cleaned. However, in 1958 this cleaning operation was moved offsite, and as a result cleaning stations or associated equipment no longer exist at Lihue Mill. When the cleaning plant was moved off site, the cane was transported from the off site cleaning plant to the mill, initially by a flume, and then by a belt conveyor. Portions of these systems have been disassembled, but the sections on the mill property remain relatively intact.

From the conveyor the sugar cane entered either Mill A or Mill B. In each, the cane passed through rotating knives where it was cut up, and then conveyed to a crusher and in turn to a shredder to form a uniform blanket which could be passed through the grinding mills. The crusher, two large rollers with interlocking corrugated teeth,

thoroughly broke down the rind, extracting a high percentage of the juice from the cane. Next the shredder separated the fibers of the cane. The cane then moved to the grinding mills. Each mill consists of a set of three grooved rollers, each weighing from twelve to sixteen tons, which squeezed the juice out from the cane. One set of rollers follows the other in a straight line, and each exerted a progressively finer crushing action.

Both Mill A and Mill B at Lihue Mill have four sets of three roller mills. By the time the cane had passed through the crusher and the first mill close to seventy percent of the sugar was extracted from the cane. Hot macerating water or cane juice was applied to the crushed cane fiber as it entered the second and third mills to assist in the extraction of the remaining sugar. The macerating water or juice could not exceed 110 degrees Fahrenheit in order to prevent the wax on the cane stalks from melting and getting into the juice. By the time the cane ended its journey through the mill train ninety-eight percent of the juice was extracted. The juice drained from the mills into collection pans and was pumped to the scales and clarifiers. The remaining fibrous material, called bagasse, was conveyed to the bagasse storage house, where it was stored and eventually returned to the mill to be used as fuel to heat the mill's steam boilers.

After being extracted from the cane, the sugar juice was weighed and clarified. Primary and secondary heaters raised the temperature of the juice to two hundred degrees Fahrenheit, the "cracking point." Milk of lime was introduced to the juice at this point in order to precipitate unwanted particles in the juice and to neutralize the natural acidity of the sugar bringing it to a PH of seven. The heating and addition of lime also arrested the fermentation process. Other precipitating agents were added at this time as well, and the juice was placed in clarifiers. The clarifiers separated the juice from any remaining sediment. The muddy sediment was not discarded, but rather was filter pressed to remove as much sugar as possible from it, with this juice sent back to the clarifiers. From the clarifiers the juice went to the evaporators.

The evaporators are a series of interconnected tanks or cells, which vary from three to five in number. Lihue operated five evaporators, which is referred to as a quintuple effect. In the evaporators the juices were heated under a vacuum to evaporate the water. Water in a vacuum will boil at a lower temperature thus avoiding the burning of the sugar. The juice passed from one tank or cell to the other, with the vapor evaporated from the juice in the first cell used to help heat the second, etcetera. Each cell progressively increased the vacuum, and thereby lowered the boiling point of the juice. In the first cell the juice was heated to or above the boiling point with a maximum pressure of five pounds. The second cell had a vacuum of five inches and the juice boiled at two hundred and three degrees Fahrenheit, while at the final cell the vacuum increased to twenty six inches and the boiling point was reduced to one hundred thirty degrees Fahrenheit. The juice entered the first evaporator containing approximately fifteen percent sugar or "fifteen brix" and exited the last as a syrup containing about sixty five percent sugar or "sixty-five brix."

From the evaporators the juice was transported to holding tanks. Here any impurities in the syrup settled to the bottom. The impurities were high in sugar content and were returned to the clarifiers to be reprocessed. The syrups in the various tanks were determined to be either high or low grade. From the storage tanks the syrup was sent to the vacuum pans, which may be considered as single effect evaporators. The syrup was placed in one of several vacuum pans, some used for low grade sugar and others for high grade. Here the thickening process proceeded under carefully controlled heat and vacuum. A supersaturated solution formed and sugar crystals, called "seeds," were introduced to induce additional sugar crystals to form and multiply. Crystallization was further encouraged by circulating the syrup in the calandria. If the crystallization process went awry at this point, the syrup had to be returned to the evaporators and remelted. When the tiny crystals grew to a proper size the vacuum pan was emptied, or in sugar parlance, "the strike was dropped." The viscous mixture of sugar crystals and molasses, called massecuite, was sent to the crystallizers, where it was cooled while being slowly turned by spiral stirrers, originally with wide blades, and later with blades made of tubing. The mixture was then heated to one hundred and five degrees, so it would flow more easily, and sent to the centrifugals. The centrifugals purged the sugar of the molasses. The cylindrical shaped centrifugals contain perforated brass baskets lined with a fine meshed brass screen and mounted on a central shaft. By spinning at high speed the centrifugals separated the sugar crystals from the molasses. The brown sugar crystals were conveyed to a storage bin and then shipped to refineries in California. The molasses was recycled to a Massecuite Heater and then returned to the centrifugals in order to remove more sugar crystals. The molasses was stored in a separate tank and also shipped.

The entire sugar making process at Lihue Mill was dependent upon steam which was produced in the mill's boiler house. The boiler house furnaces were fueled by the bagasse produced after the juice was extracted from the sugar cane. The steam powered the steam engines and steam turbines which ran the crushing mills. It also powered the steam turbo-generators which produced the electricity to run the pumps, motors, and other equipment and lights in the mill. The steam also was the source of heat used in the heaters, evaporators, and vacuum pans to transform the juice to a syrup and then to crystals.

The Lihue Plantation Company' sugar mill operated twenty-four hours a day in season, five and two-thirds days a week for thirty-seven to thirty-eight weeks out of the year. Usually the milling of a year's crop concluded in November, having begun in early March. The period between November and the start of the next year's harvest season was called the off-season. It was during this period that most of the improvements were made to the mill building and new equipment installed. During the 1920s it was estimated that the off season had to be at least two months long in order to allow for repairs and general over-hauling of equipment in the mill.

Lihue Plantation Company

Lihue Plantation Company was one of the pioneer sugar enterprises in Hawaii, having started in 1849 as a partnership between Charles Reed Bishop, William Lee, and Henry A. Peirce. It was the second sugar plantation to be organized on Kauai, and one of the earliest successful plantations in Hawaii. No sugar plantation within the islands has a longer history. In 1851 a mill site was selected in the Nawiliwili Stream valley, the same site where the mill stands today. Water power was used to drive the mill rollers which were iron bound granite crushers brought from China. A visitor to Kauai in 1853 wrote about the Lihue Estate in *Sandwich Island Notes*, observing that the plantation covered three thousand acres, part on lease, and "has been conducted at an enormous outlay of money and labor. Several miles of road, leading to the different parts of the estate, had to be made [and] the machinery in the grinding house was of superior quality, and was imported from the United States." (*Paradise of the Pacific*, Feb 1937, p17).

Open kettles provided the means for boiling the juice into syrup, and after 1855 the mill included one of the first centrifugal sugar dryers in the world, having ordered it from its inventor D. M. Weston, the head of the Honolulu firm that would become Honolulu Iron Works. The centrifugal separated the sugar crystals from the molasses in a matter of minutes, reducing production time by several weeks.

The mill's first manager, J.H.B Marshall, remained just one year, from 1853-1854. In 1854 former Protestant missionary and Punahou School teacher William Harrison Rice became manager of the plantation, a position he held until his death in 1862. In1854, Peirce sold his interest in the enterprise to a new partnership, which included Rice. Rice was given $400 a year, plus a house, firewood, and pasture. In 1856 Rice completed a 10 mile long, 2.5 feet wide and 2.5 feet deep ditch, the earliest known ditch built in Hawaii to irrigate sugar cane. This irrigation system was a combination of ditch, flume, and tunnel, which diverted the Hanamaulu Stream near its source and took it south toward Lihue through the gap in the Kilohana Crater. These tunnels were unlined and still supplied water to the mill in the 1930s.

In 1858 Rice hired Paul Isenberg as overseer, and with Rice's death in 1862, Isenberg became manager of the plantation. In 1859 the plantation's name changed from Henry A Peirce & Company to the Lihue Plantation Company, Ltd.. Isenberg remained as manager until 1878, when his brother Carl succeeded him. In addition to operating Lihue Plantation, Paul Isenberg purchased a half share of Koloa Plantation for $35,000 in 1872, organized Kekaha Mill Company in 1880, and in the following year became a partner in H. Hackfeld & Company, the sugar factor which served Lihue Plantation. In 1890 Isenberg bought out C.R. Bishop for $200,000 and gained a controlling interest in the Lihue Plantation Company.

The plantation initially encompassed 3,000 acres and expanded in size with the passage of time. In 1866 the company acquired 300 acres at Ahukini, where it later built a wharf and warehouse for shipping and storage. In 1872 it added 17,000 acres at Hanamaulu, where Isenberg erected a mill in 1877 and hired A.S. Wilcox to manage this new enterprise. A year earlier the Reciprocity Treaty with the United States had eliminated duties on the importation of sugar and began to provide new financial dividends to Hawaiian sugar planters. Shortly thereafter, in 1878, the company leased an additional 30,000 acres at Wailua. To support its expansion, the company invested in an extension of the original ditch system that "penetrated up the north side of Kilohana and tapped into higher streams, which greatly increased the volume of water.

Besides increasing the size of its land holdings, the company also grew technologically. In 1859 the first steam engine used to power a sugar mill in Hawaii was installed at Lihue. This boosted production by providing auxiliary power to turn the rollers when water in the mill pond was low. An evaporating pan was introduced at the mill in 1866. This new strike pan, manufactured by the Honolulu Iron Works Co., was the first on Kauai to use steam for sugar boiling. It was an innovation that allowed the sugar to boil more rapidly and safely through the use of a coil of pipe in which the steam could be shut off (Damon, 593). A new mill manufactured in Scotland was installed in 1870. In 1891 a narrow gauge railway system was constructed to replace the ox carts that transported the cane from the fields to the mills. At this time, increased acreage and production on the plantation was requiring forty-five carts, each drawn by as many as six to eight oxen. By 1931 the plantation had 35 miles of 30 gauge track laid, plus an additional 5 miles of portable track, and was one of 32 plantations in Hawaii to have its own rail system.

Honolulu Iron Works' plans dated 1904 indicate that Lihue Mill expanded to a twelve roller operation at that time. However, some historians cite Oahu Sugar's mill at Waipahu as being the first to introduce the twelve roller mill to Hawaii (Durant, page 49, gives a date of 1907 for Oahu Sugar's installation). A crusher was added to the line in 1913.

World War I shut off the European sugar beet producers, creating new demands for sugar and led farmers on the mainland to more intensely develop sugar beets. In 1920, following the end of the war, the market price of sugar dropped in less than twelve months from twenty-four cents a pound to five cents a pound. By January 1922 the price had dropped to three cents, where it remained until at least 1939. Between 1920 and 1935 cane tonnage increased one hundred percent on the island of Kauai, and during the 1920s increased seventy-five percent in Hawaii. For Lihue Mill, the 1922 crop totaled 18,470 tons of cane, which was processed at a rate of 49.20 tons of cane per hour. The crops gradually increased in size and in 1927 the mill processed 38,164 tons of cane at the rate of 72.48 tons of cane per hour.

Increased investment in the Lihue Mill appeared as early as 1917, but was concentrated in the period following World War I from 1919 to 1926. In 1922, American Factors, the successor firm of H. Hackfeld & Company, the original agents for the sugar company, formalized their wartime management of Lihue Plantation by purchasing the company. In order to handle the projected increased tonnage produced in the fields, American Factors wanted to increase the Lihue Mill's grinding capacity to 80 tons an hour, which resulted in a number of improvements made to the mill during this period. In 1919 a new building was built to house Mill A that included a cane shed and mill room. New machinery for the mill room included a Niles power crane and a 72" x 87'-6" wood cane carrier with steel slats, driven by twin engines. A larger crusher was installed and the Corliss Engine that powered the machine was overhauled and a new flywheel purchased. In other parts of the factory new equipment was also obtained.

Other major improvements at this time included the construction of the machine shop with heavy-duty lathes and metal working tools at the west end of the 1919 building that housed the mill train. Machinery included Niles Bement Pond Co. lathes and drills, a Catton Neill & Co. hydraulic press, and American Tools Co. shaper and lathe. With the machine shop's completion in 1920, the company no longer was dependent upon Honolulu Iron Works for all the repairs to its mill machinery. In 1921, the company built a new power house to house the new 750 kilowatt (kw) General Electric Turbo-Generator, which provided power to electrify the mill. New Boiling House equipment also was purchased, including two juice heaters, two centrifugals manufactured by American Tool Co., two Howe suspended juice scales with a fifteen thousand pound capacity, and a Richardson automatic sugar scale. The evaporator system was enlarged by the addition of two 4,000 square foot cells. Also in 1921 two 34" mud presses were purchased from Catton, Neill & Co., along with one 34" mud press from Honolulu Iron Works Co. The company invested in two sugar bag Union Special sewing machines, one seed mixer, two 18' settling tanks, a mill juice tank, a hotwell tank, soda supply tanks, many new pumps, and a Howe molasses scale.

In 1920 the mill at Hanamaulu was closed, and in the following year three of its crystallizers as well as eight of its centrifugals were installed at Lihue Mill. Later, in 1926 one of the Hanamaulu Mill's engines was also moved to the Lihue Mill to power the knives, replacing a worn out engine. All Hanamaulu's remaining crystallizers also found their way to the banks of the Nawiliwili Stream by 1926, bringing Lihue Mill's crystallizer count to 20.

To power the additional machines and equipment, a new all-steel boiler house, designed by Rothwell, Kangeter & Lester of Honolulu, and fabricated by Honolulu Iron Works, was built in 1926, as was a new brick-lined concrete stack, the product of Heine Chimney Company. Also during 1926-27, the boiler operations were improved by the addition of four new water tube boilers, which replaced two 1899, one 1912 and two 1919 Honolulu Iron Works horizontal boilers. Walsh & Weidner water-tube boilers were selected as the replacements as they had double the heating surface of the previously

employed return tubular boilers, while occupying approximately the same size space. The installation of these more efficient boilers led to a considerable savings in the quantity of bagasse used to run the boilers. Thus by 1928 the mill had four new cross-drum, water-tube Walsh & Weidner boilers, as well as seven fire-tube boilers, dating from 1919, 1920 and 1925. These provided sufficient horse power to operate the mill at ninety tons of cane an hour.

With the improvements to the power plant, other changes ensued. The mill cheeks were replaced by ones produced by Honolulu Iron Works, which had hydraulic rams that allowed the top roller to float up and down to adjust for the density of the cane moving through the mill and exert greater pressures than were previously possible. By May 1928 Lihue Mill's assistant manager, Mr. McKeever, could say, "For the past nine years we have been concerned principally with placing the factory in shape to handle the gradually increasing tonnages which have been produced. This has been done in a series of steps as required and as finances permitted. We now believe we are justified in making improvements, . . . , which will effect economies of operation." (letter dated May 25, 1928, McKeever to American Factors.)

In the Boiling House, the first cell of the quadruple effect evaporator was replaced in 1928 with an evaporator that had a 14' diameter and 10,000 square feet of heating surface. Also two new vacuum pans were installed, both manufactured by Honolulu Iron Works. A low grade pan (number six) was installed in 1925, and a high grade pan (number one) was added in 1929. The new evaporators and pans were more efficient than the old, as during the 1920s Honolulu Iron Works started to produce welded rather than riveted calandria, greatly improving efficiency by reducing leakage.

In late 1928 the company also built next to the mill a 10,000 barrel, 2,500 ton capacity, riveted steel molasses storage tank. The addition of this tank resulted from a decision to sell Hawaii molasses to C & H Sugar Refinery in Crockett, California. Prior to this time molasses was viewed as a by-product, and although some was used to augment local cattle's diets, much of it was simply dumped. With Matson's decision to equip three of its freighters with tanks capable of holding five hundred tons of molasses, the shipment of molasses to the mainland became feasible. The sugar planters joined together and entered into a contract to ship 10,000 tons a year to Crockett. Lihue Mill's new storage tank was constructed so that shipments could continue to be made in the off season. In order to get the molasses from the Lihue Mill to the ships, the Ahukini Terminal and Railway Company purchased tank cars expressly for this purpose.

Lihue Plantation Company had a record-breaking year in 1930 with a harvest of 36,506 tons of cane, and by 1931 the capacity of Lihue Mill was two thousand tons of cane per twenty-four hours. In addition to handling Lihue Plantation's crop, the mill also processed sugar from Grove Farm Plantation and Kipu. At that time the mill featured a single Honolulu Iron Works mill tandem of 14 rollers, made up of a 2-roller crusher and four sets of mills. The crusher was preceded by Ramsay revolving knives and followed

by a Jeffrey-Searby shredder. The steam plant, equipped with the four water-tube Walsh and Weidner boilers and seven Honolulu Iron Works boilers, all equipped with step ladder grates and most with tuyeres, produced more steam than necessary, and frequently three of the Honolulu Iron Works boilers were not operated. The mill had a free standing electric plant with a 750 kw General Electric turbine generator powered by the boiler house's high pressure steam. Built in 1921, the plant was sufficient to power the mill's pumps and other electric equipment. The electric plant was augmented by the plantation's hydro-electric plant located seven miles from the mill at Waiahi. The Boiling House had three Honolulu Iron Works baffled juice heaters and two unbaffled heaters, a quadruple effect evaporator, two high grade vacuum pans and three low grade pans, including a Greiner from Germany. The mill had a total of nineteen U-shaped crystallizers, six high grade centrifugals, and eight low grade centrifugals. Because there was no storage on the mill premises, the sugar was bagged and hauled by train to Ahukini wharf for shipping to refineries in California.

The present appearance of the Lihue Mill is in large part the result of a 1934/1935 reconstruction program, which was overseen by Olaf R. Olsen, the company's chief engineer and factory superintendent. As early as 1929 a new boiling house was contemplated by Lihue Plantation, with Honolulu Iron Works drawing proposed plans. No action was taken to implement those plans, and by 1931 the Great Depression had reached Hawaii. In June 1933 Lihue Plantation Company, which had held a controlling interest in Makee Sugar Company since 1910, became sole owners of that company, and its mill located in Kealia. A little over a year later, on November 21, 1934, the Makee Sugar Company formally dissolved and became a part of Lihue Plantation. To save costs, the company consolidated the Makee Mill with the Lihue Mill. Because Lihue Mill was closer to the ports at Ahukini and Nawiliwili, the Makee Mill was dismantled at the conclusion of its grinding operations in July 1934. Some of its building materials and equipment were used in the revamping of the Lihue Mill, and the remainder was kept for parts and repairs. The manager of Makee Sugar Company, C.E.S. Burns, was retained to manage Lihue Plantation Company.

To handle processing the additional cane from the Makee Sugar Company's fields, the Lihue Mill's capacity needed to expand from eighty tons an hour to one hundred thirty tons an hour. As a result, a major rebuilding and expansion program transpired at Lihue Mill with $156,000 budgeted for construction and materials and the relocation of equipment within the factory. This reconstruction project was noteworthy as, during the eighteen months it took to rebuild Lihue Mill, the mill was only shut down for three months during the off-season. Erection of the new steel-frame building and the relocation of much of the equipment occurred while grinding and other operations took place. In order to allow Lihue Mill to maintain its operations, the new mill building was built around and above the old, and the latter's wood framing was incrementally supplanted by a steel frame. At the end of 1935, Mill A, which had been constructed in 1919, and the Machine Shop, built in 1920, were the only wood-framed portions of Lihue Mill.

To handle the increased cane load, Lihue Plantation Company decided to set up a second mill line. The eleven roller mill train at the Makee Mill was moved to Lihue and set up in an addition placed at the northern side of the mill building. This mill train included a crusher, three sets of mill rollers, knives, and a shredder. To power the first and second sets of mill rollers, there were two Corliss Steam Engines, one 16" x 36" and the other, 30" x 60". In addition, a 28" x 48" Corliss steam engine from the Hanamaulu Mill, which was owned by Lihue Plantation Company but no longer operational, was brought in to power the third set of mill rollers, and if necessary, a fourth set, should the cane load demand it. A new electric crane and new gears, gear bed, and mill beds were purchased to service this mill train, now known as Mill B. With the addition of Mill B, Lihue Plantation Company became one of only four sugar companies in the Territory to operate two tandems, joining Paia and Puunene on Maui, and Oahu Sugar Company in Waipahu.

In order to power the expanded sugar mill, two 614 horse power (h.p.) water-tube boilers were also brought from the Makee Mill at Kealia. As Lihue already had four 478 h.p. water-tube and seven 208 h.p. fire-tube boilers, the addition of the two Kealia boilers gave Lihue Mill a total horse power of 4,596, which met the anticipated operating requirements with 616 h.p. to spare. To accommodate the two new boilers, the Lihue Mill's bagasse storage area and boiler house were extended by 56'-4". In addition to the water-tube boilers and the nine roller Mill B, other equipment transferred from Makee Mill to Lihue Mill included heaters, evaporators, vacuum pans, 21 ATM centrifugals, and vacuum pumps. . In addition, some of the Makee Mill's building materials were salvaged for use in the new Mill B building. In total, $84,000 was budgeted to transfer and install the materials and equipment from the Makee Mill at Kealia.

Augmenting the machinery transferred from the Makee Mill, Lihue Plantation Company expended $215,000 in new equipment. This included new, state-of-the-art Dorr clarifiers and Oliver-Campbell mud filters. Two new evaporators, cells number one and three, replaced older cells, and the remaining two cells were upgraded. Eight new Hepworth centrifugals were acquired to handle the high grade syrup. The crystallizers were increased from twenty to twenty-four, with the 1935 additions having a seventeen hundred cubic feet capacity. As a result of all the improvements, the mill's capacity increased from eighty-three tons of cane per hour to one hundred twenty tons per hour. In 1936 a third Oliver-Campbell mud filter was installed, which was an improvement recommended by American Factors, resulting from an analysis of Lihue's "cake-on-cane" percentages.

By November 6, 1934 all the equipment for the Boiling House and mill lines had been installed or relocated to their new positions, and by the end of the month the former Makee crushing units had been completely overhauled. The reconstructed mill officially opened on January 8, 1935 to start the 1935 season. Mrs. Dora Isenberg, who had

seen Lihue Mill grow from a small, water-powered operation with boiling kettles to the modern 1935 plant, pressed the button to signal the engine operators to start the mill. For the opening day, only the "A Mill" was in operation, with the Makee or "B Mill" not firing up until January 29, 1935. In the year of its opening, Lihue was the largest mill in the islands in terms of the tonnage of cane processed, at nearly 600,000 tons a year. In terms of final product, its 70,000 tons of high grade raw sugar were only surpassed by the 80,000 tons produced by the Hawaiian Commercial and Sugar Company at Puunene. The latter plant, however, milled less cane due to the higher quality of its cane.

The consolidation of the two mills led to further upgrading of a number of the Lihue Mill's facilities. The previously free-standing Lime House was incorporated into the mill building in 1937. Similarly, the detached, wood-frame power house, built in 1921, was replaced by a new power house located within the envelope of the mill, on a mezzanine floor, which was completed in 1937. The fifteen-year-old 750 kw steam turbo-generator had limited capabilities and was only providing around 600 kw of power as its blading was worn, causing the mill to sometimes use power coming from its hydro plant to augment the mill's power supply. Thus a new 2,000 kw Allis-Chalmers turbo-generator with an Ingersoll-Rand condenser was installed alongside the 750 kw turbo-generator in the new Power House. The former power house was converted into an electric shop building. In 1939 Boiler Number Twelve, manufactured by Walsh & Weidner of Chattanooga, Tennessee, was installed to increase the horse power provided to the mill in order to improve their grinding rate, and by that year all boilers had been fitted with tuyeres to improve efficiencies.

During 1939-1949, many changes occurred in Hawaii's sugar industry. The work force was unionized; first on Kauai in 1941. By the end of the war almost the entire industry was unionized. Wartime manpower shortages of more than forty percent led to the extensive and expensive conversion to mechanical harvesting, which in turn resulted in inefficiencies because of the large quantities of dirt, stones and other debris which were brought to the mill with the cane. As a result a sedimentation tank was constructed at the mill yard in an effort to reduce the amount of sediment going into Nawiliwili Stream.

Production continued to climb, however, and the mill produced an all-time record of 59,417 tons in 1947. In order to meet the demands placed upon the mill, a substantial addition was placed on the Boiler House in 1948. Boiler 1A, a Combustion Engineering Boiler with a generating capacity of 80,000 pounds of steam per hour at three hundred pounds pressure was installed in the new addition, and five years later a second, similar boiler, Boiler 2A, was added. A new stack was also placed into operation.

The power house was also expanded in 1947, and in 1948 a new steam powered electricity generator, a 4000 k.w. G.E. Turbo-Generator, began operation in a large addition to the Boiling House portion of the factory. The addition to the power house necessitated the removal of the former free-standing power house, which had been

converted into an electric shop. As a result a new electric shop was constructed in 1947 on the east side of the car loading structure on the southeast corner of the mill building.

In 1950, a 450 ton sugar bin was added to the east side of the mill, and on May 23, 1950, bulk sugar shipping operations commenced, with trucks, rather than trains, transporting the sugar to Nawiliwili Harbor. Previously, all the sugar in Hawaii had been transported in burlap bags, with sugar all bagged at the mill. The post-war period brought a move to bulk shipments, which required new types of trucks, loading and unloading facilities, and ships with sheathing in their holds to seal off cracks and crevices. With the shift from rail to truck, the Rail Car Loading Shed was converted into a warehouse. Also at this time, the detached, wood-frame office and laboratory building, which stood on the east side of the property, was demolished. In its stead a new office and laboratory were incorporated within the envelope of the mill.

The mill's operations were further enhanced by expansion of the pan floor to accommodate two new juice storage tanks in 1952. Also, another set of mill rollers was added to Mill B during 1954-1957 to make it a fourteen roller mill. In 1956, Mill B converted to steam turbines, which powered the enlarged mill train and shredder. The mill's electric power plant was expanded with a new Westinghouse turbo-generator, which necessitated the addition of a new boiler, number 2A.

In 1958, Lihue Plantation Company shifted over to transporting cane from the fields by truck rather than train. Elsewhere in Hawaii, the first major use of trucks to haul cane from the fields had occurred in 1936. At Lihue the change was completed in 1960, so that year all cane was transported to the factory receiving station by Kenworth truck tractors and twenty-four ton chain-discharge Hilo trailers. In order to make it possible to haul the cane by truck, the company began to build new roads in 1956. In 1958 the cane unloading and cleaning operations, formerly handled at the beginning of the two mill tandems, were moved off-site, as the mill yard was difficult for trucks to access, especially in inclement weather. The off-site cane cleaning plant was located at an elevation 90' above and a half mile away from Lihue Mill. This necessitated the construction of a flume system to carry the cane to the mill. This new flume, set on a two percent grade, ran from the cane cleaning plant to a divider station located on the mill property. It was 1,613 feet long and crossed over Kaumuali`i Highway on its way to the mill. At the divider station, it bifurcated, with 6' wide, 323' and 117' long flumes carrying cane to Mill A, and 6' wide, 211' and 110' long flumes going to Mill B. The first cane was transported down the new flumes to the factory on June 17, 1958. The cane unloading and cleaning stations at the mill were shut down in 1959, and Mill A's station was dismantled in 1962, with Mill B's removed in the following year.

The construction of the flume system also required enhancing the sedimentation tanks on the east side of the property, as the water used to transport the cane to the mill carried with it large amounts of dirt and other materials. The sedimentation tanks were

built to clean this water, which was then pumped up to Mella Reservoir. With the flume system in operation, the last of the railroad tracks were removed from the mill yard during the 1960 off season. In 1983, the flume was replaced by a rubber-belt conveyor, which was built on top of the old flume and remained in operation until Lihue Mill shut down. Although no longer operational, much of the carrier system remains intact on the property, although the portion which ran over Kaumuali`i Highway was removed in 2003 or 2004.

In the 1960s, the production of sugar at Lihue Mill significantly increased over previous decades, due to a jump in productivity that resulted from the use of new hybrid varieties of cane and completely mechanized harvesting. In 1964, a new concrete and steel bagasse storage building was built on the west side of the mill, about 65 feet from the mill, with conveyors that carried the bagasse back and forth to the mill.

The mill's final major building episode occurred in 1980 when a new power plant was constructed. Part of the carpenter shop had to be removed to provide ample space for the new structure.

The mill operated until November 2000, when it shut down. At the time of its closure it was one of three sugar mills to remain in operation in Hawaii. Puunene on Maui and Makaweli on Kauai still process cane, although at the end of 2008 the latter announced it intended to discontinue raising sugar as a food crop. In 2005 Pacific Funds LLC purchased the Lihue Plantation Mill Company property, and in August 2007 Lihue MS LLC acquired the property.

GENERAL DESCRIPTION AND LOCATION

The Lihue Plantation Sugar Mill is located on Tax Map Key (TMK) parcels 3-8-004: 007 and 3-8-005:009. It is situated on an approximately 13.8 acre parcel in the Nawiliwili Stream Valley on the periphery of Lihue's town center on Haleko Road.

The Lihue Plantation Company's Sugar Mill property includes four buildings, as well as a number of ancillary structures. The historic buildings include the sugar mill, bagasse storage building, carpenter shop, and Quonset warehouse. The Quonset warehouse is not owned by Lihue MS LLC and is not included in their proposed project. As a result it is not part of this HAER documentation effort. The sugar mill is addressed in this report and the other two buildings are covered in separate reports. In addition there are within the mill yard the concrete foundations for a power plant built in 1980 and a Foster Wheeler 4-Cell Cooling Tower. The buildings and equipment that sat upon these foundations were sold in June, 2007, and transported to the Philippine Islands. Both foundations are less than fifty years old and do not meet the criteria for listing in the Hawaii and National Registers of Historic Places.

The Lihue Sugar Mill evolved over time, and the present structure is the product of six major building episodes dating from 1919-1920, 1926, 1934, 1947-48, 1950-52, and 1960. As a result, the mill building's design presents a very additive composition. The four story Boiling House, built in 1934, is the focal point and organizational spine of the sugar mill, where the sugar juice is processed into crystals. To the Boiling House numerous one and two story wings, additions, and annexes are appended, housing such mill functions as management, steam production, maintenance support, shipping, and the crushing of the sugar cane. As a result the primary, east and south facing facades of the mill are comprised of lower, front facing gabled roofed structures projecting outward from the four story Boiling House and its three gable roofs with monitors. The entire mill is characterized and unified by its materials: corrugated metal siding and roofs, steel windows, and steel structural members. As a result of damage incurred during Hurricane Iniki in 1992, the original corrugated metal has been replaced in a number of places with standing seam metal roofing. Also a number of the original windows no longer exist, either having been replaced by more modern materials or simply left as open, framed holes in the walls.

Two fourteen roller mill trains are situated in a pair of two-story annexes to the north of the Boiling House. Their gable roofs with monitors run parallel to the Boiling House roofs. To the south of the mills and the west of the Boiling House, the former Fire Room or Boiler House is located. A 167' high stack, erected in 1948, adjoins the Boiler House and rises above the entire complex. The 12' in diameter base of the earlier, 1926, once 194' high stack also remains in place. The upper portions of this stack were destroyed as a result of Hurricane Iniki. A single story Mill Office and Laboratory wing is to the east of the Boiling House, as is a four story sugar bin. Two story Warehouse and Electric Shop wings extend off the southeast corner of the Boiling House

Boiling House

The Boiling House is essentially an L-shaped building, measuring 195' x 180' with a 45' wing extending to the west from its southwest corner. At its high point, it stands 104' tall. It has three gable roofed sections, which descend from four-to-three-to-two-and-half stories in a northerly direction. The gables run east to west, and a four story intersecting gable extends out from the south side. All four gable roofs are surmounted by monitors. As is true for the monitors throughout the mill building, each bay of the monitors is comprised of a six lite window flanked on either side by a rectangular ventilator with slats. The Boiling House's west side wing is two stories high and sheltered by a shed roof. It contained the mud presses. Windows penetrate the Boiling House walls on all stories with exterior faces. The placement and present condition of the windows will be discussed when the various interior spaces are addressed. Also there are multiple points of entry for the building, which will also be discussed within the context of the spaces they access.

The Boiling House sits on a concrete slab foundation, which supports the steel superstructure with its 12" I-beam columns sitting on square concrete footings spaced 20' on center in both directions. The four corner I beams measure 18". At the ground level the boiling house is enclosed by either corrugated metal walls without windows, reinforced concrete foundation walls, or abuts one of the mill's many additions, or is open to the outside. On the north side, the boiling house opens on Mill A at the ground level, and features a solid corrugated metal wall in the area of the 1947 Power House wing.

The east side of the Boiling House is enclosed by the walls of the Electrical Shop and Mill Office and Laboratory walls, and the corrugated walls of the Power House addition. The area between the Electrical Shop and the office and fronting on the sugar bin is open to the outdoors, and the space between the office and the Power House wing holds a recessed 8'-8" deep, concrete loading dock.

On the west side of the Boiling House a reinforced concrete firewall runs up the initial two floors of the building to protect it from the Boiler House, and then continues as a corrugated metal wall.

The south side the Boiling House adjoins the Electrical Shop and Warehouse, opening up to one corner of the latter on the interior. West of the Warehouse the Boiling House has a 6' high reinforced concrete foundation wall surmounted by a 60' long corrugated metal wall. This wall is penetrated on the first and second levels by two pivot windows with a twelve lite frame and four lite pivot. The final 45' at the south side's western end holds the mud filter wing and is open on the ground floor to enable rail cars, and later trucks, to pass underneath to load the remaining sediment after the sugar had been extracted by the mud presses and haul it back to the fields. Next to the rail car/truck opening, at the corner, is a metal hoist tower with an exterior ladder enclosed by a circular frame. This was added in 1961.

At the corner where the Warehouse intersects the Boiling House, on the exterior, sits a molasses storage tank, which dates back to 1928. Near the corner, metal stairs with five steps lead out of the Boiling House to the tank. The free standing round steel tank is 55' in diameter and approximately 23'-8" high, and has structural steel supports and a roof manhole. It has a 2,500 ton, or 10,000 barrel, capacity and was manufactured by Western Pipe and Steel Company of San Francisco, which was later known for its production of ships during World War II. A modern, low-pitched, corrugated metal, gable roof supported by 6" steel columns protects the molasses tank from the elements.

Adjoining the molasses storage tank is a day tank for molasses, which was constructed in 1954. The molasses was pumped from the storage tank into the day tank which discharged it into trucks that transported the molasses to Nawiliwili harbor for overseas delivery. The day tank is a cylindrical tank with a 13'-6" diameter, approximately 16' tall, which sits on a 14' high steel framework. The supporting framework is made of four 10"

I-beam columns tied together by 6" angle iron cross beams. From each corner, a pair of 8" steel channels rise at an angle to brace the underneath of the tank. The bottom of the tank tapers to a cone, which houses a drive mechanism to push the molasses out of the tank's spout. Standing near the molasses storage and day tanks, on the Boiling House side is a cylindrical tank approximately 20' tall and 4' in diameter, which stored the caustic soda, which was used to clean the evaporators and pans.

The ground floor of the Boiling House is characterized by relatively large open spaces with various equipment, providing support to different mill functions, placed at irregular intervals. Overhead runs much of the piping to transport sugar juice, massecuite, steam, and condensed water to various destinations. Prominent elements include the following. Along the south wall, next to the stairs to the molasses tank is the 30' long cylindrical Crystallizer Hot Water Supply Tank, which was installed in the 1961 off season. Approximately 30' from the south wall, and running parallel to the wall are ten low grade Silver centrifugals, which are elevated off the floor by a steel frame. They are in two rows, one of four and the other of six machines, and have metal platforms and catwalks on all sides. These are what remain of the fifteen Silver, low grade continuous centrifugals, which were installed in 1967. A centrifugal is essentially a perforated brass drum or basket that revolves at a high velocity within an iron casing. Below the centrifugals is a pair of screw conveyors that transported the sugar to a grate covered pit, whence it was moved under the floor to a cup elevator, a three-story high conveyor with rectangular cups in which the sugar was transported to the top floor. Here the crystals were deposited on an elevated conveyor belt that dumped it in the sugar bin. Between the centrifugals and the cup elevator sit two massecuite reheaters. These tanks date from 1937 and are elevated above the ground floor on a complex of platforms and catwalks which are at the same height as the Power House mezzanine floor, but independent of it. The bottom of these pans may be serviced from a platform accessed by a metal stair with thirteen steps from the Boiling House ground floor. The upper section of the heaters may be accessed by a catwalk from the low grade centrifugals.

To the north of the cup elevator is a former pair of sugar bins, which date from 1934 and most likely were abandoned in the 1950s following the construction of the free-standing sugar bin. These four-sided metal boxes with inverted pyramid shaped chutes at their bottom, are situated above the ground floor and supported by a steel framework that ties into the superstructure of the mill. Two small stainless steel vats are below the two chutes. Their function is not presently known.

Across from the former sugar bins, to the east, is the passenger elevator which was installed in 1935. It was purchased from W.A. Ramsay, Ltd. and manufactured by Pacific Elevator and Equipment Company. It traveled at a rate of 100' per minute, with a maximum capacity of 2,000 pounds. Housed in an extended metal mesh cage the push-button elevator operated from the ground to the top floor.

West of the sugar bins, mounted on a metal frame platform are the six Western States Roberts high grade, fully automatic centrifugals. Four of these date from 1962, and two Roberts CC-6 continuous centrifugals were installed in 1985. Metal stairs with fifteen treads go from the ground floor to the service platform. To the north of the high grade centrifugals, near the middle of the Boiling House's ground floor, is an electrical control room which operates the high grade centrifugals. The single story, 15' x 20' structure contains two rooms covered by a shallow pitched, hipped roof. It has metal walls and doors.

To the northeast of the centrifugal control house, the large Buffalo deaerator tank sits on a raised concrete foundation. It is approximately 6' in diameter and 20' in length. It served to collect and deaerate the condensed water before it was returned to the steam boilers. Deaerators served to remove oxygen from the condensed water before recycling it to the boilers, thus helping to reduce corrosion in the lines and boilers.

To the northwest of the deaerator is a large, approximately 10' x 15' concrete box with a flat roof and a heavy metal door. This structure housed 3 single phase, Westinghouse electrical transformers. The Power House generated electricity at 460 volts, on which the mill machinery ran. The transformers stepped this voltage up to 6,350 volts in order to sell it to Kauai Electric Company.

Beyond the dearaetor to the north are two large Ingersoll-Rand condensers, which handled the low pressure steam from the steam turbine generators situated on the mezzanine floor above the condensers. The condensers stand on reinforced concrete foundations, approximately 4' tall, with the eastern-most one sitting on springs in order to accommodate the expansion caused by the hot steam entering the tank.

Mezzanine Floor: Power House

A straight run of metal stairs with twenty-nine steps, at the northeast corner of the Boiling House, leads up to the mezzanine floor, 17'-10" above the ground floor. This level holds the 120' x 60' Power House. The Power House not only provided electricity to the sugar mill, but the entire plantation, including the irrigation system and workers' housing. Prior to 1921 the mill relied on off-site hydro-power to meet its electricity requirements. In 1921, a free standing wood frame Power House with one 750 kw G.E. steam powered turbine generator was erected. When the mill was substantially expanded in 1934, provision was made to incorporate the Power House within the envelope of the mill building on the mezzanine floor, and in 1937, this plan was executed. The 750 kw turbine was moved into the mezzanine floor Power House, and a 4,000 kw Allison-Chalmers steam driven turbine generator was also installed. To provide room for more generators, the Power House was extended 60' to the east in 1947 to form a new 60' x 60', projecting east side wing on the mill. The addition is readily evident on the interior as the addition's corrugated metal interior, north side wall has no windows. In addition, its roof has no monitor, and the newer crane beam rails

are not riveted. With the wing's completion, a 4000 kw General Electric steam turbine generator was installed, and in 1957 the final turbine generator, a 4,000 kw Westinghouse steam turbine generator with a two pass surface condenser manufactured by Ingersoll-Rand, was placed in the Power House. The Power House still contains the three most recent steam driven generators, and the place where the 750 kw generator stood remains evident. The generators' steam turbines were powered by high pressure [one hundred fifty to one hundred eighty pounds per square inch (psi)] steam, which over the course of turning the turbines got reduced to fifteen psi by the time it was sent to one of the two condensers located on the ground floor of the Boiling House beneath the generators. The turbines turned the generators to produce electricity. At the end of each generator is an exciter. A 3' wide, ten ton traveling crane beam is suspended 21' above the floor, and can traverse the length of the room on its crane rails to service the generators.

The Power House is a lofty room with a reinforced concrete floor and a 48' high open ceiling. Fink Trusses of 12 panels with King Posts, braces, and sub-diagonals support the gable roof. The room is six bays long, with each bay defined by a roof truss carried by an 8" I-beam column. The pre-1947 corrugated metal north wall abuts Mill A and has pivot windows in each of its three bays on the first and second floor levels. The pivot windows have a single row frame of twenty-eight lites with a twenty lite pivot. The three 1947 bays on the north wall have no windows, and the middle bay has cross bracing. A ladder with seventeen rungs, at the easternmost end of the easternmost bay, leads to a door which opens on a platform. Here staff could service the wires leading off site. These wires are in a conduit that runs across the mill yard on a steel trestle with a Pratt truss along its sides and cross bracing across the top.

The corrugated metal east wall of the Power House is three bays wide and features in each bay, on both its first and second story levels, pivot windows, similar to those in the north wall. In the southeast corner of the Power House wing are three Universal Blowers manufactured by the ILC Electric Ventilating Company of Chicago. Its 2'-3" x 17" ductwork runs around the interior of the Power House below the crane rail and helped cool this power plant. The blowers pulled air in from the outside through two sets of slatted louvers. The outside air passed through a bank of panels which look like automobile radiators.

Control panels line the south and west walls of the room. Control panels run for 85' along the power house's south wall. Behind these panels is a metal walled, 22' wide x 80' long storage and service space with doors on its east and west ends. At the west end of these control panels is a metal stair with fifteen treads leading down to a landing, where it takes a 90 degree right turn before descending another thirteen steps to the Boiling House's ground floor. Behind the Power House's west wall is a service space as well as the lower portions of the three clarifiers and their foundations. To the south of the clarifiers is piping and equipment associated with the Cochran Corporation's deaerator system which is located on the ground floor of the Boiling House. Near this

equipment a metal stair with twenty treads leads up to the Evaporator floor. However, this stair is not the primary means of access to this floor.

Evaporator Floor

Situated 12'-11" above the mezzanine and 30'-9" above the ground floor, the Evaporator Floor may be reached from the ground floor by three other stairways. The front stair that runs straight to the Power House continues upward an additional twenty steps to terminate at the Evaporator Floor. A second stairway begins by the office and laboratory and winds around the passenger elevator shaft. From the ground floor this metal stair ascends fourteen steps to a landing, which has a office on its south side. The metal structure measures 14'-7" x 20' and has a shed roof. A hinged metal door enters off the landing, and both the side overlooking the stair and the side overlooking the Boiling House ground floor feature sets of four fixed windows. From the landing the stair makes a right turn ascends five steps to another landing, makes another right hand turn and rises another ten steps to another landing. This landing is approximately at the mezzanine level of the Power House. Off this landing's north side a set of four steps leads up and then out to a series of metal catwalks that service the undersides of the evaporators. The elevated walkways, catwalks, and platforms found throughout the mill are made of different types of metal grating with welded bar, expanded, perforated (round), diamond plate, and rebar grates being most commonly used. From the other end of the landing the stair makes a ninety degree turn to the east, ascends ten steps to another landing before making a right turn to climb another ten steps to the Evaporator Floor. There is also a rear stair which descends from the Evaporator Floor down twenty steps to a landing platform to service the undersides of the Oliver Mud Filters and Crystallizers. A series of catwalks and stairs lead outward and downward to various service platforms for the Massecuite Reheaters and Centrifugals, and ultimately terminate at the boiler house ground floor.

The Evaporator Floor is an approximately 200' x 120'rectangular space with wings extending off the east and west sides. It has a reinforced concrete floor. Two, east-west running gable roofs with monitors shelter the northern two thirds of the space, while the Pan floor is above the southern third. Both roofs are carried by metal Fink Trusses supported by 8" I-beam columns. The northern most gable roof is a three-bay continuation of the Power House wing's gable roof. It covers the juice scales, clarifiers and milk of lime vats. A corrugated metal wall separates the upper levels of the Power House from the Clarifier space. The north wall of the clarifier area is open and looks down upon Mill A on its lower level, while the upper level of the wall contains three sets of metal framed pivot windows similar to those in the Power House, and the west wall contains one set of these pivot windows.

Four raw juice scale tanks, each 7' in diameter, fitted with 20,000 pound capacity Fairbanks scales run across the width of the space. Two of these tanks date from 1919, a third was added in 1936, and the fourth was installed sometime between 1947 and

1964. To the east of the scales are three Dorr Clarifiers, each 20' in diameter and originally of five compartments with a 5,000 cubic feet capacity. The clarifiers are spaced 26' apart on center, and a 10' high, 7' in diameter Clarifier Flash Tank, added in 1965, sits on a platform between Clarifiers One and Two. The clarifiers were manufactured by Petree & Dorr of New York, with the first two installed 1933; and the third added in 1936. Over the years these have been modified, as in 1945 two were converted to multifeed and the third was so converted in 1960. In 1988 one was modified to operate as a trayless clarifier. At the time these clarifiers were installed at Lihue Mill they were considered to be state-of-the-art, as *Gilmore's Sugar Manual* noted, "the Dorr is unquestionably superior" to any other continuous subsidizers. (Walter E. Smith, "Boiling House," Gilmore's Hawaii Sugar Manual---1931-1932, p. 51) In 1930 one third of the total sugar production in the islands came from factories equipped with Dorr clarifiers. Between and to the north of the scales and clarifiers are two stainless steel vats where the lime was mixed prior to being added to the sugar juice. These are supported above floor level by a steel framework and one sits higher than the other. A stair running up the east side of the vats, allows them to be serviced

The Boiling House Tool Room is also located on this floor in the Power House wing. It runs approximately 90' along the south side of the wing, with a corridor between it and the wing's southern exterior wall with its three banks of pivot windows. The windows are similar in design to others in this wing. The tool room is comprised of five rooms with the middle 9' x 15' room serving as an office. To the east of the office are two tool rooms, both accessed off the corridor. The eastern most is 16' long and has a metal doorway and two sets of fixed glass windows. The other is 31' long and has a metal door. To the west of the office are two storage rooms. The western most is 25' x 20' and accessed from a door that opens on the clarifiers. The other is L-shaped resulting in a 5' jog in the hallway. It is entered off the corridor via a metal doorway, and at its widest point is 8'-10".

The corridor fronting the tool room opens on the heater and evaporator section of the floor. This area is sheltered by the second gable roof and is approximately 120' long with six bays demarcated by the trusses and columns. The horizontal juice heaters are arranged in two rows at the eastern most part of this space. Four primary heaters form the easternmost row, and are of recent vintage with Heaters One and Four manufactured by Lucas Engineering Inc. of Denver and installed in 1980, and Heaters Two and Three made by Silver and dating from 1979. The secondary heaters, located a row behind the primary, were all installed in 1963 and manufactured by Duncan-Stewart of Scotland. The four primary juice heaters have nine hundred square feet of heating surface. The three final baffled juice heaters have 1,550 square feet of heating surface and bring the juice from one hundred seventy degrees to two hundred twenty degrees Fahrenheit. Next to the secondary heaters are evaporator vacuum pumps one and two, which were manufactured by the Nash Engineering Company of Norwalk, Connecticut. The model 3300 dates from 1964.

To the south of the heaters are the evaporators. The evaporators are a series of interconnected tanks or cells, and depending on their number are called triple, quadruple or quintuple effect evaporators. Lihue Mill for many years had quadruple effect evaporators, but converted to quintuple effect in 1962, which in recent times has been the industry standard. The lower part of each evaporator contains a steam drum, called a calandria, fitted with copper or brass tubes through which the juice circulates, surrounded by the steam which brings it to a boil. The tubes in the evaporators need to be cleaned with a boiling caustic soda solution on a regular basis as a scale forms on their interior surface and is a poor conductor of heat. Above the calandria is the vapor space which collects the vapors from the juice. The vapor space connects via piping with the second cell's calandria. The vapor space in the final cell connects to a condenser tank and vacuum pump. The vapor produced by the evaporation of the juice's liquid in the first cell is used to help heat the calandria of the second cell, etc. This method of utilizing the vapors, rather than boiler house steam, to heat the subsequent cells was developed at Lihue Mill by G.H.W. Barnhart. Owing to the rapidity of evaporation there is entrainment of juice with the vapors. In order to capture this sugar, the vapors on their way to the next cell pass through a "save-all," essentially an expanded pipe with a series of baffles upon which the sugar collects as it passes through the save all. All five cells at Lihue mill have external save alls mounted on their tops.

There are six evaporators placed in a west to east running row, with Cell One being westernmost. Cell One was installed in 1962, and is 17' in diameter with 5,784 tubes, each 8'-1/2" x 1-3/4", providing 24,000 square feet of heating surface. It was made by Duncan-Stewart of Glasgow. Cells Two, Three and Four are each 14'-6" in diameter. Cell Two dates from 1935 and is also a Duncan-Stewart. It contains 4,246 tubes, each 8'-3" x 1-3/4", providing a heating surface of 14,418 square feet. It received a new calandria in 1960. Cell Three was manufactured in 1928 by Honolulu Iron Works, and originally was Cell Two. It was made Cell Three in 1962 off season when the new Cell One was installed. It contains 4,080 tubes, each 6'-2" x 1-3/4", with a heating surface of 10,660 square feet. Cell Three, installed in 1969, was made by St. Mary Iron Works, Inc. Cell Four was installed circa 1920 and contains 4,140 tubes, each 6'-2" x 1-3/4", also with a heating surface of 10,660 square feet. The final cell, manufactured by Silver, dates from 1979. It replaced an evaporator cell made in 1948. A sixth evaporator stands at the end of the line, and was manufactured by Catton, Neill & Company in 1920. It does not appear to have been operational at the time of the mill's closing and is not connected to the quintuple effect evaporators.

Directly in front of evaporators 2 and 3 is the evaporator floor office. It is a single story, 10' high, metal structure with a flat corrugated metal roof. Measuring 13'-6" x 12'-4", it has three wood framed, fixed, plate glass windows in the front, and one metal door on its west side and two others on the east side.

Behind the evaporators, occupying the entire southern part of the floor, are the mill's crystallizers. These are mounted on steel frames above the floor. A metal stair with eleven steps leads up to a series of catwalks which serve the crystallizers. The twenty-four open crystallizers are each rectangular in plan and have a half cylinder cross-section with a powerful spiral stirrer on a rotating cam shaft, which was developed in the late 1930s. There are twenty crystallizers measuring 7' x 22' and 4 measuring 8'-4" x 32'. The former were originally fabricated by Honolulu Iron Works in 1911 for the mill at Hanamaulu, and each has a 914 cubic foot capacity. The latter each have a capacity of 1,600 cubic feet, and were installed in 1935. Some of the original crystallizers have been replaced over time as is evidenced by some of the vats being welded rather than riveted. Originally the crystallizers had flat broad bladed stirrers, but these were replaced with the present tube stirrers which allow the massecuite to be heated or cooled by running either hot water or cold through the tubes. The hot water system for the crystallizers was upgraded in 1961, with a new 4,000 gallon hot water storage tank installed on the ground floor.

To the west of the evaporators and crystallizers were four Mud Presses or Vacuum Filters, which were sold in June 2007, and sent to the Philippine Islands, along with their belt conveyor system. Three were 8' x 12' Olivers and one was an A. Jord. The Oliver mud presses were developed during the 1920s and manufactured by Oliver United Filters Inc. of Oakland, California. They were the most efficient means of recovering the sugar remaining in the sediment after clarification at the time of their installation at Lihue Mill. The Oliver Filters were large, slow-revolving cylinders surfaced with a fine mesh copper screening. The drum circulated through a bath of sediment-filled juice, to which bagasse was added. An intricate inner system of tubes produced a powerful vacuum that sucked the juice through the screens, leaving the filter cake affixed to the screening. A scrapper bar removed the cake from the screen. Initially two were installed in 1935, and a third was added by 1948. The date of the A. Jord has not yet been documented.

The Oliver Mud Presses occupied the entire shed roofed, 50' x 120' wing on the Boiling House's west side. The operation utilized the entire two-stories, with the actual presses on the Evaporator Floor, with the conveyor system at the mezzanine level and the rail cars, later trucks, to haul away the mud on the ground level. The wing is six bays long with each bay demarcated by one half of a Fink truss with sub-diagonals which supports the shed roof. Each bay on the Evaporator Floor has a pair of metal, pivot windows with twenty-four lite frames and an eight lite pivot. At the mezzanine level, the windows are absent, although their openings remain.

Adjoining the mud filter wing on the southwest corner of its west wall is a small, 30' x 20' almost completely open addition which houses the lime and soda operation. This operation includes three large vats and sits on a concrete and steel grate floor. Two steps at the mud press mezzanine level lead out a window opening to a metal catwalk that passes directly over two of the three vats before a set of twenty metal steps leads

down to the ground. Another ten steps lead from the floor of the lime house into the boiling house's ground floor. In the 1969 off season a new gable roof was placed on this structure.

Pan Floor

The top, or Pan, floor raises 18'-8" above the Evaporator Floor. Two sets of metal stairs run between the two floors. One continues the stairway winding around the elevator. From the evaporator floor it ascends nine steps to a landing, where a five-rung ladder accesses the belt conveyor that transports the sugar crystals to the bin. From the landing the stair makes a right turn and runs another nine steps where it reaches another landing, makes another right turn and journeys the final ten steps to the Pan Floor. The other stair runs parallel and next to the mud filter wing and has two runs of fifteen steps each, with a landing in between.

The Pan Floor is a 140' x 80' rectangular space with a reinforced concrete floor sheltered by an intersecting gable roof, with monitors on each ridgeline. Its east-west running gable roof is seven bays long and the south running gable is only one bay, with all bays demarcated by nine-panel, metal Fink Trusses with king posts and sub-diagonals, and by 8" I-beam columns that rise up from the Evaporator Floor. The areas either side of the south gable are covered by shed roofs.

Two syrup storage tanks and seven vacuum pans are on this floor. The Pan floor was extended in 1953 to accommodate the two rectangular, 20' x 40' Pan Supply Tanks, which sit under the shed roofs. There is no concrete floor under the tanks, but rather the steel bottom of the tanks rests on 24" steel I-beam girders. The storage tanks have an eight thousand cubic foot capacity for syrup and remelt, and seven thousand cubic foot capacity for molasses.

There are seven calandria type vacuum pans, each served by an individual condenser and a Nash Hytor motor-driven vacuum pump. There are four high grade pans. Pan One is a 14'-9" diameter cylindrical tank with a 3,585 square foot heating surface and 1,800 cubic foot capacity (baffled); which dates from 1929. It was manufactured by Honolulu Iron Works and is sheathed in 2" tongue and groove strips covering insulation and bound together by 3" iron bands. Pan Two is a high grade seeder with a 12' diameter, 1,972 square foot heating surface and a 1,210 cubic foot capacity (baffled). It dates from 1928 and was built by Honolulu Iron Works for Makee Mill, coming to Lihue in 1934. This cylindrical tank is covered in vertical running corrugated aluminum bolted onto a metal framing. Pan Four was installed during the 1959 off season, and has a 3,002 square foot heating surface and a 2,000 cubic foot capacity (baffled). It is sheathed in wall board screwed onto a wood frame. Pan Five, installed in 1964, has a 17'-9" diameter, 3,000 square foot heating surface and a 2,000 cubic foot capacity (baffled). Manufactured by Fletcher & Stewart of England, it is a low head vacuum pan,

which was popular during the 1960s. It is sheathed in wall board on the bottom and aluminum sheets above.

In addition, there are three low grade Pans: Pan Three was manufactured by Catton, Neill in 1917 and moved to its present position in the 1957 off season. It has a 10'-6" diameter, 1,240 square foot heating surface and 750 cubic foot capacity (not baffled). It is sheathed in 14" aluminum bands. Pan Six dates from 1925, and was fabricated by Honolulu Iron Works. It has a 14'-9" diameter, 2,016 square foot heating surface, and 1,600 square foot capacity (not baffled). Wallboard on a wood frame covers a riveted iron inner shell. Pan Seven with a 10'-6" diameter, 3,000 square foot heating surface with a 1,000 cubic foot capacity (baffled) originally came from Makee Mill in 1933. This Kilby pan was manufactured in 1899, and refitted in 1933 with a Honolulu Iron Works flat calandria and bottom. Its cast iron door reads, "Honolulu Iron Works Company, 1941." It is covered with 33"-wide pieces of aluminum sheathing. All the pans have eye glasses, or lunettes, through which the progress of the boiling liquid may be observed, and all have save alls mounted on their tops. The pans originally were individually supported by Nash Hytor Vacuum Pumps, which were installed between 1961 and 1969. A number of these have been removed, and now only Pans Four, Five, and Six still have their pumps.

Mill A

At ground level, to the north of the Boiling House, are the two mill trains. The Mill A annex adjoins the Boiling House and features a gable roof with a monitor. The mill runs in an east to west direction and at its far end, under the same roof, is the factory's Machine Shop. Although the roof is continuous, Mill A and the Machine Shop each have individual monitors. Mill A was constructed in 1919 and the Machine Shop in 1920. Both originally had wood frames. The framing was converted to steel in 1939-1941. Two of the original framing members, a pair of 12" x 12" timbers, which help support the crane rail, stand on the north side at the juncture where Mill A and the Machine Shop merge. Mill A is 120' x 60' and the Machine Shop extends the structure an additional 215'. Nine-panel, double Fink trusses with a king post and sub-diagonals support the roof. The trusses are supported by 10" I-beams that sit on two steel plates and square concrete footings. Mill A is five bays long, and the Machine Shop is eleven bays in length, with the trusses defining each bay. A fifteen-ton Niles traveling crane services the Mill. The crane rails are supported by 8" I-beams placed on battered concrete footings that are 5' tall and spaced 12' on center.

The base of the mill is approximately 5' below grade and has dressed lava rock walls and a concrete floor. The mill train and its steam engines occupy almost the entire space. Steel platforms and walkways, elevated approximately 8'-6" above the floor, run along the two sides of the mill train and provide access to that equipment. On the north side of the mill train two sets of stairs, each with fourteen treads, run from the floor to the platform in the area by the shredder and the first mill. On the south side of the mill

train three sets of stairs, each with nine treads, lead from the platform down to the floor where the engines that power the mill train are situated.

As the former cane unloading and cleaning operations were situated at the east end of the mill, the mill building is open on that side at the ground level. The east gable end, above the open ground level, is clad in corrugated metal, with a translucent corrugated plastic used in areas which once had windows. The south side of the building is completely open to the Boiling House on the ground floor, as well as much of the Boiling House's mezzanine floor, with corrugated metal siding only at the upper levels of the easternmost end of this side, behind which the power house is situated. Fixed-pane clerestory windows, a number of which are broken out, run down a portion of this wall as well. The north wall of Mill A also has corrugated metal siding at its easternmost end, broken only by a 6'-4" wide opening which leads to the outdoors down three concrete steps. The parts of Mill A and Mill B that adjoin are open to one another.

The mill train runs the length of Mill A. A portion of the conveyor that brought the cane in from the no-longer-extant cane unloading and cleaning station (dismantled in 1962) still remains. It leads to the Meinecke knives, which date from 1934. After these revolving knives comes a two-roller, 34" x 78" Krajewski crusher fabricated by Honolulu Iron Works in 1920. The Krajewski Crusher was invented by a Polish engineer of that name working in Cuba during the opening decade of the twentieth century. It is readily recognizable by the chevron patterned corrugations that are welded longitudinally across its surface. The crusher is followed by a 42" x 72" Jeffrey-Searby Shredder, which dates from 1919. This shredder was invented by William Searby, the superintendent of the Hawaiian Commercial Sugar Company on Maui in 1914, and was fabricated by Jeffery Manufacturing Company of Columbus, Ohio. By 1929 one third of Hawaii's sugar mills had installed shredders as part of their mill line.

Following the shredder is the first mill. Intermediate carriers then transport the sugar to a Macerator, and then mills two, three, and four follow. The first and second mills were fabricated by Honolulu Iron Works, with the first dating from 1913 and the second from 1904. The third and fourth mills were manufactured by Fulton Iron Works of St. Louis, Missouri, and date from 1897 and 1895, respectively. Fulton began manufacturing sugar mills in 1891, and the company claims to have revolutionized the sugar industry by introducing a nine-roller mill that was driven by common gearing and a single engine. The two Fulton mills in Mill A are powered by one Corliss Steam Engine.

On the ground level, in the area where Mills A and B converge are located three mixed juice pumps with a mixed juice tank standing next to them.

Mill A crushed 90 tons net cane per hour. Its four mills each have three large cylindrical rollers that measure 34" x 78". There are two lower rollers, the first called the "cane or feed roller" and the last the "bagasse or discharge roller" with one roller on top. These rollers have Messchaert grooves. Developed in 1913 by P. A. Messchaert, the mill

superintendent for Oahu Sugar, these grooves in the surface of the rollers were somewhat deeper and wider than those that were then in use and they greatly reduced slippage as the cane passed through them and improved extraction of juice. In addition, mills two, three, and four have a small roller at the front, which is called the force feed roll, which was introduced in the 1970s to some mills in Hawaii in an effort to squeeze even more juice out of the cane. The rollers are supported in massive iron castings called housings or mill cheeks. The mills at Lihue use housings with hydraulic rams which allow the top roller to float up and down to accommodate the density of the cane passing through. The hydraulic rams and mill cheeks for mills one and three were purchased from Honolulu Iron Works in 1948, and in 1952 for mill two.

Mill A is powered by three Corliss single piston steam engines. The crusher was driven by a Nordberg Corliss Engine with an 18" cylinder diameter and a 42" stroke, which was purchased in 1920. The two front mills were operated by a 28" x 54" Nordberg Corliss Engine which dates from 1919, and the two back mills by a 28" x 54" Nordberg Corliss that in 1948 replaced a 28" x 48" Hamilton Corliss that had been installed in 1931. Three flywheels, each 16' 3" in diameter with six spokes, smoothed the rotation of the Corliss engines and absorbed their energy. Three bull gears, pinions, and another set of reducing gear boxes reduce the steam engines' 80-90 revolutions per minute (rpms) down to the 4 rpms at which the mills turned. The mills' steel gears have cut teeth and were manufactured by Farrel-Birmingham Iron Foundry in Buffalo, New York and date from 1927.The shredder was driven by 200 h.p. General Electric motor, and the knives by a 150 h.p. General Electric motor.

Machine Shop

Mill A flows into the Machine Shop with the sole demarcation being the termination of the metal platform surrounding the mill line. Four steps near the southwest corner of the platform descend to the floor of the Machine Shop. The machine shop is essentially a large open space, with the only intrusion being a diminutive, 16' 6" x 16' 6", 15' high, office/tool room in its southeast corner. The office/tool room is sheathed in sheet metal and has a flat roof. A bank of four, wood frame sliding windows dominates the façade of the office/tool room, while a bank of three similar windows is on the west side. To the right of the front bank of windows is a door which accesses the office space. On the east side of the structure ten steps lead up to a second floor storage area. A sheet metal door secures the entry. A set of double doors on the front side of the structure provide additional access to the storage area. The south side of the shop shares a common wall with the boiler house. This fire wall is made predominantly of reinforced concrete with several courses of cut lava rock wall which formed the lower portion of the original bagasse storage area's wall. On the north side the Machine Shop is completely open to Mill B and on the ground level of its west end has lost a large portion of its corrugated metal wall, although the gable end remains well sheathed.

The Machine Shop has two Niles fifteen-ton traveling cranes, which share the same rails. The rails' support structure is the same as in Mill A. In addition, several other pieces of the original machinery, too heavy to remove easily, still remain in the machine shop. These include: a universal drill press and three lathes manufactured by Niles-Bement & Pond of Plainfield, New Jersey, and a 36" universal drill press made by Gould & Eberhardt of Irvington, New Jersey. The three lathes measure 48" x 34', 36" x 32', and 18" x 12'.

Mill B

Mill B adjoins the Machine Shop on the shop's north side and runs parallel to it. It was completed in January 1935, when the operations of Lihue and Makee Mill at Kealia were consolidated. This annex measures approximately 160' long, 60' wide, and 30' high to the bottom of the trusses, and features a gable roof with a monitor. It has a steel frame and nine-panel, double Fink trusses with king posts and sub-diagonals support the roof. The trusses are supported by 10" I-beams that sit on the concrete foundation walls of the mill. Mill B is eight bays long with the trusses defining each bay. A Niles fifteen-ton traveling crane does all the heavy lifting, and its rails are supported by 8" I-beams placed on battered concrete footings that are 5' tall and spaced 12' on center. The mill has a concrete floor. A partially below-grade reinforced concrete base wall, 18" thick and 5' high adjoins the Machine Shop.

The walls of the below-grade reinforced concrete base of the mill range from 3' to 8' in height, gaining in height at the east end. The mill train and its steam turbines occupy most the mill's space; however, there is a work area on the floor of the east end with lube oil storage lined up along the end wall. A shed roofed structure containing the engineer's office and mill tool room is appended to the east end of the mill building.

The 45' x 30' office/tool room adjoins the north side of Mill A, and thus is readily accessible to both mills. It is accessed from the outside. A set of ten steps rise up along the north wall of Mill B to lead outside, and three steps exit Mill A directly in front of the office/tool room. The office/tool room has corrugated metal walls is five bays long with banks of fixed, metal framed, six paned windows in the three middle bays. The windows all contain wire mesh safety glass. The far right hand bay features a metal sliding door that accesses a storage room, and the extreme left hand bay contains a 3'-9" opening without a door that enters a foyer. The store room runs the depth of the structure, with three banks of windows, similar to those on the façade's middle bays, running down its north wall. A metal door on the south side wall of the store room leads to a lateral running central hallway that has two enclosed office spaces on its west side. On its east side are three cages enclosed by expanded metal mesh walls and riveted metal walls. Tools were kept in these cages. The two offices each are accessed by doors off the hallway, and have a connecting door in their partition wall. They have sheet metal walls and canec ceilings. The offices have three sets of three sliding

windows each of six panes that look out on B Mill, and the office adjoining Mill A has a set of four sliding windows, all of six panes each.

Mill B operates in a west to east direction. At the west end of Mill B are the remains of the original cane unloading and cleaning station. This 80' x 50' structure has a corrugated metal gable roof supported by three double Fink trusses, each with a king post and sub-diagonals. The sides are open in all four directions, and six 10" I-beam posts support the trusses. From the floor to the bottom chord of the truss measures 11'. Near the southeast corner of the cane cleaning station a pair of steps, one metal and one concrete, but each with three treads, goes up to the metal platforms and walkways that access and allow servicing of Mill B's machinery. Elevated approximately 8' above the floor, the platform runs along both sides of the mill train. Between, but east of, the two pair of stairs leading up to the platform is a stair with nine treads which descends to the mill floor.

Because of the cane unloading and cleaning operations at the west end of the mill, the mill building is open on the ground level at this end, while the gable end is clad in corrugated metal. The south side of the mill is open to the Machine Shop. The north wall of Mill B features non-original 6'-9" x 8' steel framed, Lucite, awning windows, welded in an open position. There is one four lite window for each bay on both the first and second stories. The east wall is dominated by the engineer office/mill tool room on the first floor, above which is the corrugated metal sided gable end. Along the wall lubricating oil was stored. Translucent corrugated plastic covers former window openings in the gable end.

The mill train runs much of the length of Mill B. Most all this machinery derived from the Makee mill and was installed at Lihue in 1934. A portion of the conveyor that brought the cane in from the off premises cane cleaning operation still remains. At the juncture where the conveyor enters the mill, the induction controller remains intact. This device automatically adjusted the speed at which the cane was conveyed through the mill train, depending on the quantity of cane being fed into the mill. Invented by Honolulu engineer Alan Lloyd in 1959, it was installed at Lihue Mill shortly thereafter. Upon entering the mill the cane is sent through the Ramsay Revolving knives, which were originally installed at Kealia in 1928. After the revolving knives comes a two-roller, 34" x 72" Krajewski crusher fabricated by Catton, Neill & Company of Honolulu in 1919, which is followed by a 42" x 72" Jeffrey-Searby Shredder, which also dates from 1919.

Following the shredder is the first mill, followed by mills two, three and four. Intermediate carriers once transported the sugar to a Macerator, between mills one and two, but this has been removed from its platform above the mill tandem. The first three, 72" wide mills were fabricated by Honolulu Iron Works in 1899 for Makee Mill. The fourth mill was not added until sometime between 1954-1957. At the far end of the mill is a bagasse carrier which intersects with a conveyor running in a north-south direction.

The conveyor also intersects with Mill A's tandem and transports the bagasse from both mills to the bagasse storage building.

Mill B crushed 105 tons net cane per hour. Its four mills each have three large cylindrical rollers that measure 34" x 72". There are two lower rollers, the first called the "cane or feed roller" and the last the "bagasse or discharge roller" with one roller on top. These rollers have Messchaert grooves. In addition, mills two, three, and four have a small roller at the front, which is called the force feed roll, which was introduced in the 1970s to some mills in Hawaii in an effort to squeeze even more juice out of the cane. As in Mill A, Mill B utilizes housings with hydraulic rams which allow the top roller to float up and down to accommodate the density of the cane passing through.

Mill B is powered by three Terry Turbines, which are situated on the Kapaa side of the mill train and were installed in 1956. These turbines drive the crusher, mills one and two, and mills three and four. Western State high speed and low speed gear boxes and pinions translate the energy of the turbines to fit the needs of the mills. These turbines operate under high pressure steam, which enters the turbines at one hundred fifty psi, and eventually leaves at fifteen psi. The shredder was driven by 400 h.p. Westinghouse Life Line motor. The electric motor which powered the knives is no longer extant.

Boiler House

The Boiler House is to the south of the Machine Shop and west of the Boiling House. The 22' high common walls it shares with these other parts of the mill are poured in place, reinforced concrete fire walls. The Boiler House is comprised of three distinct areas, each under its own roof. The 1926 Bagasse Storage area is immediately south of the Machine Shop, and is sheltered by a corrugated metal shed roof that runs parallel to the Machine Shop sloping down in a northerly direction. The 1926 Fire Room is to the south of the Bagasse Storage Area and runs parallel to it. It originally had an east-west running gable roof, which has lost its corrugated metal roofing, much to the detriment of the now skeletal framing members. To the south of the now open-air fire room is the Steam Generation wing whose gable roof runs perpendicular to that of the 1926 Fire Room. It was constructed in 1948, and its roof is equally as absent as that of the 1926 Fire Room. The entire boiler house was abandoned in 1981, following the completion of the new Power House.

The Bagasse Storage Area is a long rectangular space, approximately 20' wide and 215' long, with a 16' x 10' room at its west end. From the floor to the bottom chord of its roof truss is 22'. The storage area has a concrete floor and 6" thick concrete walls, and is open on the south side to the fire room whose boilers the bagasse fueled. It was accessed from either end through flat arched openings in its concrete end walls. No longer extant, metal stairs went up from the Boiling House floor to the Bagasse Storage Area on the east end. On the west end three metal steps lead up from the outside to an

interior metal grate landing. From the landing seven steps go down to the floor of the Bagasse Storage Area, while six go up to the boilers. The 30' high wall on the room's north side readily discloses the 56'-4"extension to the Boiler House undertaken in 1934 to accommodate the additional Makee Mill boilers, as the extension is made completely of reinforced concrete while the earlier part of the wall has five courses of cut bluestone at its base. Running above the room are two no longer totally intact bagasse conveyors which delivered the bagasse by way of chutes to the boilers' furnaces. Each boiler was fed by two chutes, except Boiler Twelve, which had three chutes servicing it. The conveyor system was added in the 1955 off season.

The Bagasse Storage Area and Fire Room were fabricated by Honolulu Iron Works in 1926, following plans by Rothwell, Kangeter & Lester of Honolulu. The Fire Room's rectangular plan measures 46' x 215' and was capped by a gable roof with a monitor. The roofing no longer exists, leaving only the skeletal framework of the monitor and the Fink trusses between the interior, now resembling a courtyard, and the sky. The trusses sit on 30' tall 6" I-beams, which on the bagasse storage side are encased with concrete for approximately their initial 9'. The columns demarcate the twelve bays of the structure. Brick encased fire boxes, or furnaces, are located at either end of the room. These are set 5'-7" away from and rise approximately 6' above the bagasse storage area. The furnaces have small segmental arched cast iron doors, fabricated by Honolulu Iron Works near their bottoms facing the bagasse storage area. The fire boxes have step grates on their interior, which were added in 1931 to allow for a more efficient burning of the bagasse.

Seven water tube boilers manufactured by Walsh & Weidner of Chattanooga, Tennessee, sit on top of the fireboxes. The box-like, riveted metal boilers are set back from the north edge of the fireboxes by 11'. Three boilers are at the west end of the room and four are on the east end. The east end boilers, numbers Eight, Nine, Ten and Eleven, all date from 1926 and have 4780 square feet of heating surface. Boilers Thirteen and Fourteen came from Makee Mill and were installed in 1934 with Detrick arch furnaces with air cooled and insulated walls. Boiler Thirteen dates from 1929 and Number Fourteen from 1927, while the last boiler, number Twelve, was purchased in 1939 and supplanted three older boilers. All the boilers have heavy, riveted double doors except Number Twelve, which has three doors. The metal duct work for the air intake and exhaust systems, including the Multiclone Fly Ash Collectors, which date from 1963, is still readily evident, although now missing segments.

The south wall of the Fire Room is open and faces out on the Steam Generation Wing, which was added to the mill in 1948. This three story, 87' x 55', free standing structure is 8' away from the Fire Room and its barely extant gable roof and monitor framing runs perpendicular to the former roof of the Fire Room. It is only enclosed by a wall on the west side, where a corrugated metal wall rises to the eave line. The wall is broken by four banks of fixed pane, metal windows at the second story. Each bank has eighteen panes (6 x 3). A pair of wood, sliding windows, each of four lites, is to the right of the

fixed pane banks. The addition was constructed to accommodate Boiler 1A, a Combustion Engineering Boiler with a generating capacity of 80,000 pounds of steam per hour at 300 pounds pressure. In 1953, a second, similar boiler, Boiler 2A, was added. Both were heated by Detrick arch furnaces, manufactured in Mokena, Illinois. The wing sits on a reinforced concrete basement that is 9'-8" deep, which served as an ash pit with an ash conveyor transporting the ash from the basement to trucks that took it to the cane fields to help fertilize the next crop. At the corners and along the sides of the foundation walls 8" I-beam columns rise to form the basic framework for the structure.

A set of six metal steps on the north side, near the west corner, go from the ground to the first floor of the steam generation wing. Two large, metal furnaces with doors centered on their west sides occupy this floor. Two large ducts enter these furnaces on each side and the front, and served to force draft air into each of the furnaces. In addition, small rectangular tuyeres, four on the front walls and six along each side, helped regulate the air supply. Four chutes entered each furnace near the top and fed bagasse to the mini-infernos. A Buffalo Induced Draft Fan, located on the ground below the furnaces propels the smoke up the stack.

On the west side of the Steam Generation Wing, at the north corner a set of exterior, metal steps lead to the second floor. The steps have fifteen treads to a landing, make a ninety degree turn to the right and ascend another eight treads to the second floor. Banks of control panels line the west wall and wrap partially around the south wall. Opposite the control panels are the two boilers. A hallway with a sheet metal floor runs between the two elements. The box-like, metal boilers rise up a full two stories, with a series of ladders and catwalks servicing the higher elevations. A framework which includes 24" wide I-beams supports each boiler. Each boiler has supplemental oil burners, installed in 1955. A six rung ladder accesses a metal platform used to manage the oil burners. The oil burner for Boiler 1A has been removed.

The control panels run along the south wall for 15', where a 44" opening leads to the second floor of a two-story, open-air, addition, placed on the wing in 1960. This addition houses the feedwater station. This station sits on a diamond plate metal floor enclosed on three sides by a pipe railing, and includes three Ross Filters, a J.T. Worthington deaerator tank, standing 27' high and measuring 10'-6" in diameter, and an oil-fired boiler manufactured by Weaver Brooks of Milwaukee. The latter replaced a hot well tank in 1968, and sits under a shed roof which covers a15' x 27' area to the west of the other apparatus.

Steps with twenty-five treads lead from the second floor of the feedwater station down to the ground. Underneath the feedwater station, are the pumps that serviced the boiler house. As with the feedwater station, these date from 1960. Only four pumps remain, although six vacant, raised concrete foundations and historic drawings indicate more pumps once occupied this area. Of the four remaining boiler feed pumps, one is

powered by an Allis-Chalmers electric motor, and the three remaining are powered by steam turbines, two of which were manufactured by General Electric. The feedwater station and Boilers 1A and 2A were decommissioned in 1981 when the new power plant and Foster Wheeler 4-Cell Cooling Tower commenced operation.

Between the feedwater station and the Boiling House stands the Boiler House stack. Constructed in 1948 when the steam generation wing was built, this brick lined, steel chimney rises 168' from the ground and is 12' in diameter. To the northeast of this stack is the previous, now truncated, concrete stack. Built by Heine Chimney Company in 1926, it is 12' in diameter, and once had a height of 194'.

Office and Laboratory

The Office and Laboratory addition was built in 1951. It replaced an earlier single-story wood frame, free standing building that was in the close proximity of the addition's location. The Office and Laboratory addition is a single story structure with a front facing gable and a slightly right of center entry. A shed roof protects the entry's hinged door from the elements. Four steps lead up to the front door. To the right of the door is a window with twelve fixed lites and a center awning window of four lites. A similar window is to the left of the door, and to the left of that is a bank of three similar windows. At the left corner is a two panel, hinged door with a window in the top panel. The addition's walls are of corrugated metal except for the initial 19' of the north side wall, which is of reinforced concrete and wraps around the northern most 8' of the façade. The side wall of the office and laboratory facing the sugar bin is six bays deep, with a window, similar to those in the front, in each bay, except the third from the front which has a door.

A 5' wide central hallway runs the depth of the office and laboratory, with a rear door exiting into the Boiling House. On the right side of the hallway are the offices, and on the left side the laboratories. Unless otherwise noted, all the spaces have sheet metal walls and canec ceilings. The first office encountered upon entering is the Mill Planner's Office. Its main room measures 12'-6" x 28'. A small, 8'-10" x 8' office and a concrete lined 8' x 19' vault run along the north wall of the office. A single, hinged door provides access, and two windows each with twelve side lites with a six lite awning in the middle allow light and air from the hallway to enter the room.

Beyond the Mill Planner's Office are a restroom, a conference room, and the factory manager's office. The restroom is accessed from both the hallway and the conference room. The 14' x 21'conference room has both canec clad walls and ceilings. Doorways from the hallway and the factory manager's inner and outer offices enter the conference room, which has a window fronting the hallway which is similar to those in the mill planner's office.

The Factory Manager's Office is split into two rooms, an outer and an inner office. A metal partition wall separates the two rooms, and may have been added at a later date, as all the other walls in these rooms are canec clad, as is the ceiling. The outer office measures 11'-8" x 10'-4", while the inner office is 11'-8" x 10'-3". A doorway connects the two offices, and the inner office has a doorway which exits directly into the Boiling House. The outer office has a hall window similar to the others in the building.

The Laboratory sits across the hallway from the offices, and was used by the factory chemists to analyze the sugar in the cane fiber and the purity of the juice. The laboratory is a large, irregularly shaped space which runs the depth of the addition. Three offices, a storage room, three other rooms, and an emergency shower, of varying dimensions define the laboratory's side walls. A front, corner office measures 10' x 10'-3" and has a private entry from the outside. Opposite this office are two other offices, each 7'-5" wide, the first 10'-8" deep and the other 11'-5". These are connected to each other by a doorway, and each also has doors opening on the hallway and the laboratory. They each have a window, similar to others in the addition, which looks out onto the laboratory. A 9' x 20' store room partitions the laboratory into two distinct areas. The storeroom can be accessed from both the laboratory and the outside. Opposite the storeroom is a small, 6'-6" x 10' room, which is adjoined by a double doored pass-through via which mill samples were delivered to the chemists from the hallway.

To the rear of the laboratory are two other rooms, one small 7' x 5', the other larger and L shaped whose main body measures 8' x 17', with a 2' x 10'-6" jut. A 7' x 6'-3" emergency shower is on the south wall of this area of the laboratory. A rear wood doorway exits into the Boiling House.

Sugar Bin

The Sugar Bin was added to the mill in 1950. It is a four story structure with a low pitched, front facing gable roof. The second and fourth stories have walls of corrugated metal with no windows, while the third story is of sheet metal with the steel framing articulated. The sheet metal is the exterior skin of the sugar bin housed by the structure. The bottom floor is open on all sides. The sugar bin is a free standing, 27' x 35' structure, with a total capacity of 450 tons of sugar. It is sited 18' away from the east side of the Boiling House, with its sole connection to the mill being a fourth story, enclosed, belt conveyor. Corrugated metal shed roofs on both the front and rear elevations protect the open bottom floor from the elements. The rear shed roof 's eave line comes within 4' of the Boiling House, solidifying the relationship of the mill and bin.

Twelve 10" I-beam columns forming three front-to-back rows support the sugar bin. They sit on battered concrete footings which are approximately 2'-4" high and 2'-10" wide at their base. Cross bracing made of 4" angle iron runs between the columns on the two sides and provides lateral stability.

The structure sits on a concrete floor with two bays for trucks to enter. Two 10" high concrete bollards, one in each bay, help guide the trucks into their proper locations. They are 37' long and 2' wide, run almost the length of the bin and taper at their front ends. Each of the bays has three chutes descending from the bins. The chutes' four sides converge at a fifty seven degree angle, which allowed for the most controlled flow of sugar from the bin to the trucks, without having sugar adhere to the sides of the chutes. In the middle of the two bays is a metal platform, 8'-10" high. It is accessed by a stair with thirteen steps at its rear or a seven-rung ladder at its front. The platform is 46" wide and allowed the drivers to access the wheels that controlled the gates for each of the chutes. There are six yellow wheels, one to control each chute. They are 7' in diameter and have seven spokes which encompass 2/3rds of the wheel.

Warehouse

Originally developed as the railway car loading barn, this structure was converted to a warehouse in 1952, when the mill converted its means of transporting sugar from bags by rail to bulk by truck. It adjoins the Boiling House on its south side and is an 80' x 72' rectangle with a broad, front facing corrugated metal, gable roof, with shed roofs on either side. It is four bays wide with three roll up doors, each 20' wide and 27' high in the first, third and fourth bays. The third bay has a single, hinged door which accesses the Warehouse office and a four pane awning window framed by twelve lites. The corrugated metal walls of the two middle bays are penetrated by a window in each bay. The windows have center awning windows of four lites, surrounded by twelve fixed lites. The Warehouse is six bays long, with windows, similar to those on the façade, in each bay.

The interior of the Warehouse is one large open space with a concrete floor and a single story, 22' x 15'-8" office at the south end. The flat roofed structure has metal walls and contains two offices which share a metal partion wall with a door and a window with three sliding wood-framed windows. The north facing wall of the office features a two-panel, hinged door with a window for a top panel and three fixed, single pane windows in a wood frame, while a pair of fixed windows are set in its west wall. The other office has sliding windows in wood frames on both its east and west walls. A metal door on the south wall accesses the outdoors.

The Warehouse is open to its roof with the steel nine panel Fink trusses with king posts and sub-diagonals supporting the gable roof, and half Fink trusses with sub-diagonals supporting the shed roofs on either side. At the northwest corner of the Warehouse is a 34' x 19' loading dock which opens on the Boiling House. The loading dock sits 6' above the Boiling House floor level, and is accessed from below by a set of ten concrete steps. A five-ton Wright moving crane services the Warehouse, with its rails supported by 8' steel channels, which also serve as the Warehouse's structural framing. The

easternmost bay of its north wall has 6" angle iron for lateral cross braces on the Boiling House side of the corrugated metal wall.

Electric Shop

In 1937 when the Power House was moved onto the Boiling House mezzanine, the Electric Shop moved into the former, free standing Power House that had been built in 1921. When the Power House added its new wing in 1947, the 1921 Power House building was demolished. As a result an addition was placed on the Boiling House to accommodate the electric shop. Constructed in 1947, this addition stands on the east side of the Warehouse/car loading structure and on the south side of the Boiling House. The three story, 80' x 128' addition stands 38' high and features a skewed gable roof with a 4H:12V slope. Its walls and roof are of corrugated metal, and it features sixteen lite, steel frame windows with the middle four frames pivoting. The south elevation is four bays wide. The two western most bays each have 12' x 14' doorways with roll up doors, and a pair of windows above at the third story level. The third bay features a pair of windows on the first and second stories with the top west window having been converted to jalousie. The western most bay has a pair of windows on the first story and one on the second. The rear, north, elevation is five bays wide and has a pair of windows on both the first and second stories in its three westernmost bays; its easternmost bay has only a pair of first story windows and the next bay in has two windows on the ground floor and one window above. The addition has an open four bay wide inset car parking bay area under roof on the east side, and two large, hinged, corrugated metal, double doorways access an enclosed parking area. The enclosed garage area has a pair of windows on each side wall, and in the rear five concrete steps lead up to the electric shop.

The electric shop has a concrete slab floor, and in the southwest corner of the interior is a 28'-6" x 6'-6" reinforced concrete repair pit where mechanics could work on the locomotives which transported the cane to the mill. The 72' track, which uses 45 gauge rail, still remains in the floor. A 6' wide traveling crane beam is suspended 24' above the floor, and can travel the length of the room on its crane rails to service the locomotives. The crane spans 35'-2" from crane rail to crane rail. The open ceiling features a Fink Truss which supports the corrugated metal roof. A mezzanine, 12' high and 18'-8" wide traverses the east and a portion of the north side of the shop. It is accessed by a metal stair with fourteen steps at its north side.

Sedimentation Tank

To the east of the mill building is a reinforced concrete sedimentation tank. It initially was placed in service in 1941 to support the cane cleaning operations of Mills A and B. When the cleaning operation was moved off site, the sedimentation tank was upgraded and expanded to address the muddy water used in the flumes to transport the cane to the mill. Flumes, no longer completely extant, ran between the mill and the

sedimentation tank. The tank is raised above the ground, and a set of eighteen metal steps leads to its top. The tank runs in a north-south direction and is divided into four sections, two pair of tanks parallel to each other with a common mid-line wall. A metal catwalk follows the midline wall, and weirs separate the northern and southern tanks.

The mill building retains its integrity, with its numerous alterations or additions made over time contributing to its historic significance

SOURCES

Original Drawings:

Over 1,000 original drawings and blue prints for the Lihue Plantation Company Sugar Mill and its machinery exist. These abandoned drawings were discovered in the mill office, and are incomplete. The plans will be deposited in an appropriate repository, which has yet to be determined. The following drawings provided information for this report.

Title & Sheet #	Date	Office in Title Block	Drawn by	Drawing Number
6 Ft. Double Effect Vacuum Apparatus	April 1883	Lihue Plantation		89
Addition of Pan, 7 ft. Diam to Lihue Double-Effect	June 6, 1886			
Chimney, 84' x 100'	Jan 28, 1899	Philadelphia Engineering Works		111
Arrangement of Twelve Roller Mill, Lihue Plant	August 1904	Honolulu Iron Works		4-36
Arrangement of Crane Columns	July 1904	Honolulu Iron Works		4484
7' x 18' Open Crystallizer	Aug 1906	Honolulu Iron Works		37-33
7' x 22' Open Crystallizer	June 1911	Honolulu Iron Works		37-110
Proposed Addition of Crusher and One 34" x 78" Three Roll Mill	March 11, 1913	Honolulu Iron Works		9493
Lathe; order number 80251	n.d.	Niles-Bement-		4241

		Pond Co. Plainfield, NJ		
Arrangement of 34" Filter Press	April 6, 1915	Catton, Neill & Co.	D.K.	F-25000
Proposed New Building and Increase to Boiler House	Nov 9, 1916	Honolulu Iron Works		72-74
Proposed Alterations and Additions to Boiling House	Nov 9, 1916	Honolulu Iron Works		72-73
Sectional View 10' 6" Dia. Vac. Pan	July 17, 1917	Catton Neill & Co.	H.B.A.	E-3470
Settings for Boilers	July 20, 1919	Honolulu Iron Works		105-127
Assembly of Searby Shredder Installation	July 29, 1919	Catton, Neill & Co.	P.K.E.	S-4317
Building for Evaporator House	Mar 5, 1920	Catton, Neill, and Company	D.K.	R 4786
H.R.T. Boiler	May 6, 1920	Catton Neill & Co.	D.E.S.	B-4866
6' Diameter condenser	May 22, 1920	Catton Neill & Co.	M.C.L.	A-4873
Sectional View of 11'6" Evaporator	July 14, 1920	Catton Neill & Co.	D.E.S.	E-4892
General Arrangement of Quadruple Effect Evaporator	August 1920	Catton Neill & Co.	D.K.	E-4959
Sectional View of 11'6" Evaporator	Sept 28, 1920	Catton Neill & Co.	F.M.B.	E-5118
Section "AA" W & W Boilers	Revised 4/9/26	Walsh & Weidner		
Setting Plan for Cross Drum Boiler	Mar 29, 1926 Revised 4/9/26	Walsh & Weidner	J.R.K.	
General Arrangement for Mud Press Station	May 18, 1926	Lihue Plantation	O.R.O.	
Section Through Boilers	May 22, 1926			
Bagasse Hopper & Hand Firing Door	Feb 26, 1927	Walsh & Weidner	J Hunt	A-6596
Water Tube Boiler Setting Plans (12 & 13)	n.d.	Walsh & Weidner	J Hunt	C-7201
Calandria for 12' Dia Vacuum Pan	Apr 19, 1928	Honolulu Iron Works		35-389
Arrangement of 14' 6" Diameter Pre-Evaporator	Aug 14, 1928	Honolulu Iron Works	A.A.	42.103
Steel Belt Calandria for 14' 6" Pre-Evaporator	July 21, 1928	Honolulu Iron Works	A.K.H.	43-590
Single Tandem Setting, Tubular	Nov 30, 1928	Honolulu Iron		105-23

Boiler and Flue Boiler		Works		
Proposed Floor Plan of Factory	Jan 14, 1929	Honolulu Iron Works		72-114
Cross Section of Proposed Factory	Jan 15, 1929	Honolulu Iron Works		72-115
Present Floor Plan of Factory	Jan 17, 1929 Up to 1933	Honolulu Iron Works		72-117
Present Vacuum Pan Floor of Factory	Jan 17, 1929	Honolulu Iron Works		72-118
Bagasse Furnace	July 20, 1929	Grace Brothers	E.A. Rogers	D-418
Boiling House Evaporator Vapor Piping Elevation	Sept 14, 1933	Lihue Plantation	F.N.T.	18-2
Boiling House Evaporator Vapor Piping Plan	Sept 15, 1933	Lihue Plantation	F.N.T.	18-1
New Conveyor and elevators, Details	July 30, 1930	Lihue Plantation	O.R.O.	
Plan View of Boiler Settings	Sept. 23, 1930			
General Arrangement of Makee Mill-Tracks and Broken Car Repair Yard	October 18, 1933	Lihue Plantation	O.R.O.	1-7
Boiling House Vacuum Pan Floor Beam and Column Sheet	Nov 25, 1933 Updated Aug 9, 1963	Lihue Plantation	O.R.O.	1-3
Map Showing Lihue Mill and Premises	Dec 7, 1933	Lihue Plantation	F.N.T.	29-7
Lihue Plantation Boiler Building	n.d.	John Young		
Steel Boiler Building	n.d.	Rothwell, Kangeter & Lester		
Furnace for W & W Boiler	Feb 10, 1934	Edwin A. Rogers	E.A.R.	D-526
Boiling House Floors	Mar 17, 1934	Lihue Plantation	J.T.O.	1-196
Boiling House Floors	March 27, 1934	Lihue Plantation	J.T.O.	1-195
Boiling House Floors	June 7, 1934	Lihue Plantation	J.T.O.	1-193
Proposed Layout of Juice Line, Makee Mill to Scale Tank	June 22, 1934	Lihue Plantation	K.O.	Job 97-B
8 ElectricCentrifugals	July 24, 1934	S.S. Hepworth Co. Machines	H.S.F.	23-12
Foundation Plan W.W. Boilers	Sept 13,1934	Lihue Plantation		Job 92
General Arrangement of Vapor Piping for Final Juice Heaters	Dec. 4, 1934	Lihue Plantation	O.R.O.	22-11
Boiling House Peck Strainer Location for Mud Press Feed	Feb 25, 1935	Lihue Plantation	F.N.T.	29-36
Boiling House Second Floor	Apr 1935	Lihue Plantation	F.N.T.	1-28

Plan, Evaporators, Heaters & Clarifiers				
Vacuum Pans Calandria Drain Piping	Oct 22, 1935	Lihue Plantation	F.N.T.	19-4
Plan of Lihue Mill & Premises Showing Fire Hydrants	October 5, 1937	Lihue Plantation	M.M.	29-41
Boiler Room Extension	Dec 29, 1938 "obsolete"	Lihue Plantation		
Stairs and Walks for Boiler House	Mar 30, 1939	Lihue Plantation	O.R.O.	32-56
Outside Fire System, Lihue Mill	July 24, 1940	Lihue Plantation		
10 water Driven Centrifugals	June 24, 1941	Western States Machine Co.	R.H.	6118
Furnace Details for 8 & 9	Feb 28, 1944	Lihue Plantation	O.R.O.	32-72
Furnace Details (10 & 11)	Mar 18, 1944	Lihue Plantation	H.M.	32-73
Proposed 14'-6" Dia Evaporator	June 7, 1944	Honolulu Iron Works		42-157
Guide to Piping on Rearrangement of Evaporator Cells	August 21, 1944	Lihue Plantation	O.R.O.	18-23
Extension to Mill Power House Building Floor Beam Layout	June 13, 1947	Lihue Plantation	M.M.	1-315
Mill Power House Extension, Sectional Elevation	Mar 4, 1947	Lihue Plantation	M.M.	1-307
Extension to Mill Power House Floor Framing Plan Job 195	Nov 25, 1947	Lihue Plantation	Clyde Holt	
New Electric Shop Building	Feb 1, 1947	Lihue Plantation	M.M.	1-302
High Grade Molasses Station Modifications	May 16, 1963	Lihue Plantation	M.M.	23-106
Lihue Plantation Factory Layout	July 29, 1964			.
Steam Generating Plant Main Steam and Exht. Steam Piping Diagram	July 29, 1964	Lihue Plantation	M.M.	22-28
Oliver Filter Station Showing Outline of Present Mud Screw Conveyors	August 31, 1964	Lihue Plantation	M.M.	16-10
New 7' O.D. Flask Tank Inst'll General Layout	October 19, 1965	Lihue Plantation	M.M.	12-25
Factory Drainage System	Mar 30, 1949 updated c.1967	Lihue Plantation	M.M.	1-304
Factory Drainage System	Mar 30, 1949 updated 2/69	Lihue Plantation	M.M.	1-304
Plan of Lihue Mill and Premises	June 22, 1955	Lihue Plantation	F.M	29-41

Showing Fire Hydrants	Updated 9/65			
Plan of Lihue Mill and Premises Showing Fire Hydrants	June 22, 1955 Updated 4/62	Lihue Plantation	F.M	29-41
Plan of Lihue Mill and Premises Showing Fire Hydrants	June 22, 1955 Updated 11/67	Lihue Plantation	F.M	29-41
Installation of Hot Water System for Crystallizers	June 20, 1961	Lihue Plantation	M.M.	21-6
The Silver Continuous Centrifugal, Layout Arrangement	April 6, 1965	Lihue Plantation	M.M.	23-108
Vacuum Pan Floor Layout	Jan 21, 1966 Updated 1969	Lihue Plantation	M.M.	19-26
58" Silver Continuous Centrifugals, 15-Unit Installation, General Arrangement	Sept 20, 1966	Lihue Plantation	M.M.	23-115
Installation Layout for 8' x 16' Oliver-Campbell Can Mud Filter	May 6, 1970	Lihue Plantation	M.M.	16-14

O.R.O. = Olaf R. Olsen, Chief Engineer for Lihue Plantation

Lihue Plantation Company Records:

The Hamilton Library at the University of Hawaii at Manoa serves as the repository for the Hawaiian Sugar Planters' Association's (HSPA) Plantation Archives. Approximately 140.5 cubic feet of materials pertain to the Lihue Plantation Company, the third largest record group within the HSPA collection. The following files provided useful information:

LPC-7/13: C.E.S. Burns Weekly Letter to Amfac, 1933-1935

LPC-7/14: C.E.S. Burns Weekly Letter to Amfac, 1936-1938

LPC-9/15: D Correspondence, 1937-1939

LPC-11/1: General Correspondence, Amfac 1933-1934

LPC-11/10: H Correspondence 1921-1924

LPC-11/11: H Correspondence 1924-1930

LPC-11/12: H Correspondence 1930-1934

LPC-11/13: H Correspondence 1934-1936

LPC-11/14: H Correspondence 1937-1938

LPC-14/13: M Correspondence 1921-1933

LPC-15/7: Miscellaneous Correspondence, 1928-1932

LPC-15/8: Miscellaneous Correspondence, 1929-1932

LPC-15/14: O Correspondence, 1921-1940

LPC-19/10: Mill, Manufacturing & Engineering Department, 1921-1922

LPC-19/11: Mill, Manufacturing & Engineering Department, 1923-1924

LPC-19/12: Mill, Manufacturing & Engineering Department, 1925-1926

LPC-19/13: Mill, Manufacturing & Engineering Department, 1927-1928

LPC-19/16: Mills, Manufacturing & Engineering Department, 1932

LPC-23/2: Mills, Manufacturing & Engineering Department, 1933-1934

LPC-23/3: Mills, Manufacturing & Engineering Department, 1934

LPC-23/4: Mills, Manufacturing & Engineering Department, 1935

LPC-23/5: Mills, Manufacturing & Engineering Department, 1935

LPC-23/6: Mills, Manufacturing & Engineering Department, 1936

LPC-23/7: Mills, Manufacturing & Engineering Department, 1936-1937

LPC-23/8: Mills, Manufacturing & Engineering Department, 1937

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Garden Isle

"New Lihue Mill Starts Grinding Its First Crop," January 8, 1935, page 1.

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Mott-Smith, S., "Combustion of Bagasse and Factory Steam Balance," 1939, pages 40-41.

Bromley, George, "Crystallization in Vacuum Pans and Crystallizers," 1939, pages 41-42.

"Factory and Plantation Data Section, Lihue Plantation Company, Ltd." 1939, pages 158-164.

"Factory and Plantation Data Section, Lihue Plantation Company, Ltd." 1947-48, pages 208-212.

"Factory and Plantation Data Section, Lihue Plantation Company, Ltd." 1951, pages 103-110.

"Factory and Plantation Data Section, Lihue Plantation Company, Ltd." 1954, pages 87-96.

"Factory and Plantation Data Section, Lihue Plantation Company, Ltd." 1957, pages 88-96.

"Factory and Plantation Data Section, Lihue Plantation Company, Ltd." 1966, pages 67-73.

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Hawaiian Sugar Planters' Association, *Sugar in Hawaii*, Honolulu: Hawaiian Sugar Planters' Association, 1949.

Honolulu Star Bulletin

Sommer, Anthony, "Final Harvest for Sugar Fields," November 16, 2000, page A-1.

"Two Kauai Sugar Mills Sold to Investors," April 15, 2005, page C-1.

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PROJECT INFORMATION

The following documentation was prepared in response to the proposal by Lihue MS, LLC to demolish the historic property and build housing on the 13.8 acre parcel. The purpose of this documentation is to historically record the architectural and mechanical elements of the mill and its supporting structures. The Hawaii State Historic Preservation Division (SHPD) in a July 15, 2008 letter indicated that the office believed the mill complex met the criteria for inclusion in the National Register of Historic Places. SHPD and property owner have agreed that the mill complex is over fifty years old. SHPD recommended that HABS documentation be completed and submitted to the

National Park Service as a means of mitigating the loss of this historic property. The owner agreed to the SHPD's request for documentation, and after further discussion between Mason Architects and SHPD concerning the presence of intact machinery in the mill, it was decided the documentation would follow Historic American Engineering Record (HAER) standards.

The project manager for the HAER documentation was Polly Cosson Tice of Mason Architects, Inc. Don J. Hibbard, Ph.D. and Wendy Wichman of Mason Architects were the researchers and authors of the reports. Both Polly Cosson Tice and Don Hibbard are architectural historians who meet the Secretary of the Interior's Professional Qualifications in architectural history. Carol Stimson of Mason Architects assisted with the editing and production of the reports. The large-format photographs were taken by David Franzen of Franzen Photography.

Figure 1: Location map.

U.S.G.S. Map, Lihue, Hawaii, 1983