Mitigation Plan, Humboldt Bay Power Plant

Prepared in Response to

California Energy Commission CUL-10

For Demolition of Units 1, 2, and 3

Prepared by

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On Behalf of

CH2M Hill

and

Pacific Gas & Electric Company

July, 2009

Table of Contents

1. Condition of Certification CUL-10

JRP was contracted with CH2M Hill on behalf of PG&E to prepare a mitigation plan that fulfills the Condition of Certification CUL-10 for demolition of Units 1, 2, and 3 for the Humboldt Bay Generating Station California Energy Commission (CEC) license. This plan mitigates for the demolition of Units 1, 2, and 3. This plant, composed of two gas-oil fired steam turbine units with one of the nation's first commercial nuclear powered generator, serves the Humboldt load pocket, a region of electrical demand that is somewhat isolated from the remainder of the California grid. In 2003, PAR Environmental Services evaluated Unit 3 and recommended that it appeared to meet the criteria for listing in the National Register of Historic Places at a national level of significance. The State of California's Office of Historic Preservation concurred in this assessment. This evaluation did not include Units 1 and 2. Later it was determined that the three units should be considered as a complex, and that mitigation measures should be developed for the complex as a whole. CEC Condition CUL-10 requires that a Mitigation Plan be prepared for the demolition work to assure that the adverse effects / negative impacts caused by the demolition would be mitigated.

The entire Condition of Certification CUL-10 is quoted here:

> **CUL-10** The project owner shall develop a historic resources mitigation plan for the entire Humboldt Bay Power Plant property, including Units 1, 2, and 3 and all appurtenances. The plan shall be developed under the direction of a person meeting the Secretary of the Interior's professional qualifications for historian or architectural historian. The plan shall include the following elements:
>
> > A. A thorough historic background statement that describes in detail the development of the Humboldt Bay Power Plant (Units 1, 2, and 3 and all appurtenances) in the context of Humboldt County and the Humboldt Load Pocket, describes the history of power generation technology in the area and identifies the place of the Humboldt Bay Power Plant in local, regional, and national history.
> >
> > B. A fully developed historic themes and contexts statement that identifies the key historic themes in association with which the Humboldt Bay Power Plant gains significance and the scope (topical and geographical) of significance at the national, regional, and local levels.

C. A fully developed mitigation plan that identifies, for the entire property and under the assumption that the entire property will be demolished, the key actions proposed to mitigate each significant aspect of the property, considering Units 1, 2, and 3 and all appurtenances on the PG&E property.

Mitigation actions can and shall include photographic recording to the standards of the Historic American Engineering Record (HAER), archiving of engineering drawings or other engineering documents, and archiving of historical photographs and documents relating to the development, construction, and operation of the facility. The plan shall address elements of the property's significance and the preservation of mitigation documents and other materials on a national, state, and local level.

The mitigation plan shall include the elements to be documented under Conditions CUL-8 and CUL-9, notwithstanding that the mitigation of properties identified under CUL-8 and CUL-9 may be completed before the mitigation plan is finalized and reviewed by all parties.

Verification: The project owner shall submit the Historic Property Mitigation Plan to the CPM for review and approval and to the Heritage Documentation Program (HDP) of the National Park Service, California Coastal Commission (CCC), Humboldt County Community Development Department, and California Office of Historic Preservation for review and comment. The owner shall allow up to 180 days for the National Park Service and up to 90 days for the other entities to comment on the draft plan and shall consider their comments in revising the plan. In the event that the comments are in conflict or are inconsistent, comments and direction of the National Park Service shall take precedence. The project owner shall finalize the plan and provide copies of the final plan to the HDP, CCC, Humboldt County Community Development Services Department, Humboldt State University Library Humboldt Room, Humboldt County Library, COHP, and Nuclear Regulatory Commission 180 days before demolition of Units 1, 2, and 3 will begin. The plan shall be implemented prior to demolition.[1]

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[1] On March 23, 2009, PG&E met with CEC staff and received approval to remove the Unit 3 transformers, turbine generator, and turbine prior to the approval of the mitigation plan, provided that photo documentation first be conducted consistent with HABS-HAER-type recordation. A second meeting between PG&E and the CEC was held on May 19, 2009 to further discuss the HBPP demolition schedule. At this meeting, the CEC agreed that Unit 3 demolition could occur in the absence of the National Park Service Heritage Documentation Program guidance, provided under CUL-10 through reviewer comments

This report serves as the mitigation plan pursuant to Condition CUL-10, Section 2 of this report provides a discussion of the historical context in which the development of the units can be understood. Section 3 describes the themes which are important for understanding the significance of the complex, and for establishing mitigation measures. Section 4 presents mitigation measures. Finally, Section 5 provides a bibliography of references used in this report.

2. Historical Background

2.1 The Electrification of Humboldt County

When Thomas Edison first publicly displayed his incandescent light bulb at his lab in Menlo Park, New Jersey in December of 1879, and in 1882 established the world's first steam generating power station, he demonstrated that such systems could provide electricity to nearby street lamps and houses. At about the same time, residents of Humboldt County used local natural resources to provide electricity to their towns until they connected with the greater California power system.

As of 1878, residents of Eureka and its environs lit their streets and homes with gas lights, with fuel provided by small local gas companies like Eureka Gas Company and Eureka Gas Works. Gas was not the only option for the people of Humboldt County, as local lumber mills produced and sold electrical power. In 1883, the Excelsior Lumber Mill on Gunther (Indian) Island in Humboldt Bay used arc lighting to provide nighttime illumination at its mill. Two years later, in 1885, a local electrical, sawmill, and hotel owner installed arc lights in front of the Vance Hotel and brought electric light to the streets of Eureka. Farther down the coast, the Humboldt Milling Company in Fortuna supplied electricity for indoor use to the people of the Eel River Valley. In 1896 the company installed a furnace and boiler in which they burned wood waste to drive a 60 kilowatt steam powered generator. The surrounding towns of Carlotta, Hydesville, Alton, Rohnerville, Fortuna, and Loleta were the main recipients of this power source. In

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on the required mitigation plan, the level and extent of photo-documentation of Unit 3 structures (and of any other Humboldt Bay Power Plant historic distict structures undertaken at this time) would be determined by David DeVries and Rand Herbert, as consistent with the requirements of HABS-HAER-type recordation.

the same year, Ferndale also installed a wood burning steam electric generating plant that offered lighting from dusk until midnight.[2]

North of Eureka, Arcata was independently creating its own electricity through other means. In 1895, the town allowed the Arcata Electric Company to install a water wheel that was powered by the flow in the city water mains, and was able to run five street arc lights. This system soon proved to be insufficient, and power for the city was thereafter supplied by a local mill yard owned by the same company, but under a different name.[3]

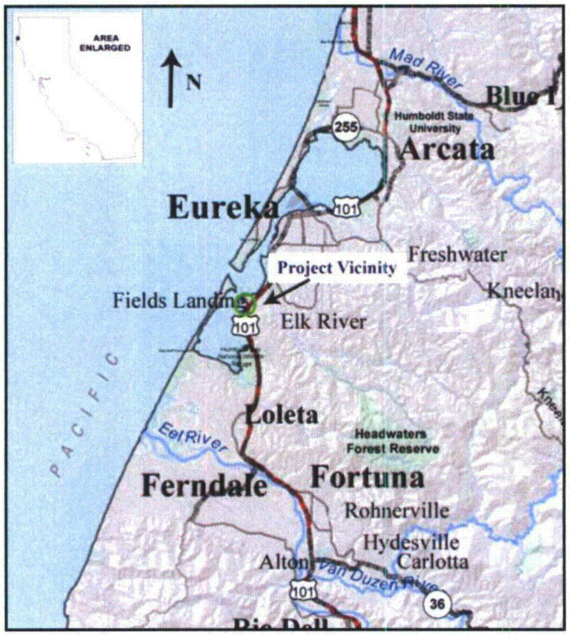

Figure 1. The Humboldt Bay Region

The companies that originally supplied the Humboldt area with electricity were small competitors who, for reasons of finance and fires, were forced to consolidate. The first of these companies was Eureka Electric Light Company (established 1886) that acquired one of its competitors, Humboldt Electric Light & Power Company (established 1885) in 1892, when a fire burned down the steam plant housing. Eureka Lighting Company (established 1894) then consolidated with Eureka Electric Light Company in 1894 and gained control of both the gas and electric utilities within Eureka. Humboldt Milling Company (established 1896) sold their generating equipment and rights to the Fortuna

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[2] Charles M. Coleman, *PG&E of California: The Centennial Story of Pacific Gas and Electric Company 1852-1952* (New York: McGraw-Hill Book Company, Inc., 1952), 44; Dan Villa, "The Inception of the Electrical Industry in Humboldt County," *Humboldt County Historical Society Newsletter* (Nov.-Dec. 1963), 16,18.

[3] John A. Mitchell, "Water Wheel Brought Lights to Arcata," *The Humboldt Historian* (Mar.-Apr. 1978), 1,4; Villa, "The Inception ," 18.

Lighting Company (established 1904) in 1904. Humboldt Manufacturing Company (established pre-1895), which was initially a mill yard, eventually became Arcata Light & Power Company in 1905. Northern Mountain Power Company (established 1902) built a dam, hydroelectric unit and transmission line to send electricity to Eureka. In 1905 it was consolidated into the Humboldt Gas & Electric Company (established 1905) along with the Eureka Lighting Company (established 1894) in 1908. Humboldt Gas & Electric Company (established 1905), Arcata Light & Power (established 1905), Ferndale Electric Light Company (established 1896), and Fortuna Lighting Company (established 1904) were all bought and consolidated into the Western States Electric Company between 1910 and 1911. In 1927 PG&E acquired Western States Electric Company. Since then PG&E has provided the region's electrical power.[4]

2.2 *PG&E in Humboldt County*

When PG&E acquired Western States Electric Company, it inherited all of the company's generating equipment and distributing network. In Eureka, this included a transmission line from a dam and hydroelectric power plant in Trinity County and two steam turbine stations. North Mountain Power Company at Junction City on the Trinity River built the hydroelectric plant in 1904. It initially provided 1,500 kW of power and with improvements over the years the output increased to 30,000 volts. The power from the dam traveled along a 65 mile transmission line to Eureka that was sent to Station C (See Figure 2, showing the regional transmission lines as of 1931). The station was built the same year as the dam and housed a 1,000 kW steam powered generator. Humboldt Gas & Electric added 500 more kW to the station after 1907. In 1916 the company closed the station and moved one of the generators into Station B to be used as a synchronous motor. Station B was built in 1910 at the waterfront end of Whipple (now 14th) Street, originally with a 1,700 kW steam turbine-powered generator and became the center of Humboldt's power distribution.[5] In PG&E's annual report of the Department of Electrical Operation and Maintenance in 1930, it was reported that Station B in 1929 used 26,455 barrels of oil and produced 6,393,000 kilowatt hours, and in 1930 used 13,222 barrels of oil and produced 13,538,000 kilowatt hours. Once the Humboldt Bay Power

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[4] Coleman, *PG&E of California*, 281, 350, 362; California Railroad Commission, *Decisions of the Railroad Commission of the State of California Volume XI September 1, 1916 to November 30, 1916* (Sacramento, 1917), 894; Villa, "The Inception," 14, 17,18; Mitchell, "Water Wheel Brought Lights to Arcata," 1

[5] California Railroad Commission, *Decisions of the Railroad Commission*, 895; Villa, "The Inception," 14,18; Leigh H. Irvine, *History of Humboldt County California with Biographical Sketches of Leading Men and Women of the County who have been Identified with its Growth and Development from the Early Days to the Present* (Los Angeles: Historic Record Company, 1915), 128.

Plant units were up and running, the station was finally closed in 1962, and the power plant at the hydroelectric dam followed two years later.[6]

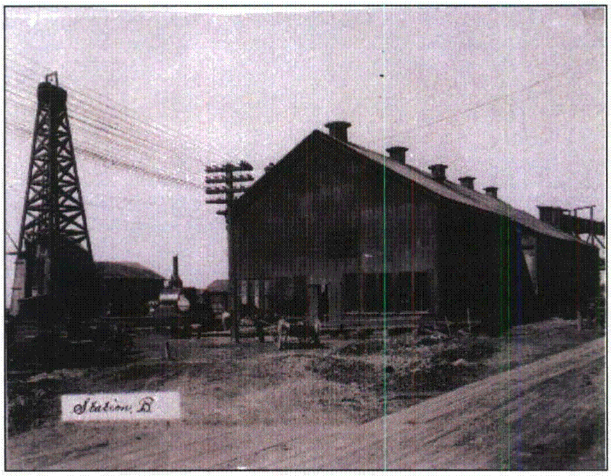

Figure 3. Station B (Courtesy of PG&E)

A unique electrical generator that became part of Humboldt's power distribution for a decade was part of the wreckage of a World War II tanker. The tanker was built in 1944, given to the Soviet Union the same year under the Lend Lease Act, and renamed *Donbass III*. It survived the war, but in 1946 it broke in half during a storm in the Bering Sea. The stern section, with its engine room, stayed afloat, was salvaged, and towed to Seattle a few days later. In 1947 PG&E bought the wreckage, towed it to Eureka to a waterfront site near Station B, and connected *Donbass III*'s 6,700 horsepower steam generator to the main grid. The makeshift system produced 4.996 megawatts for the power-hungry lumber mills in the surrounding area that were trying to meet the demands of the post war lumber boom. PG&E used the *Donbass III* generator until 1958, when it was sold as scrap, having been replaced by construction of the Humboldt Bay Power Plant complex units.[7]

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[6] Pacific Gas & Electric, *Pacific Gas and Electric Company Annual Report of the Department of Electrical Operation and Maintenance*, 1930, 164; Villa, "The Inception," 18; Interview with Richard McKenna, May 28, 2009. Current aerial photographs indicate that Station B has been demolished.

[7] Villa, "The Inception," 18; Scott Blakey, "Can-Do!," PG&E intranet site. There is disagreement whether or not the surplus ship's watertight doors used in various locations in HBPP Unit 3 were part of the *Donbass III*. According to long-time plant operations personnel Rod Nelson and Richard "Mac" McKenna, they were not; however, other long-term employees believe that they were. Research into the contract for scrapping the *Donbass III* may provide information to determine this fact.

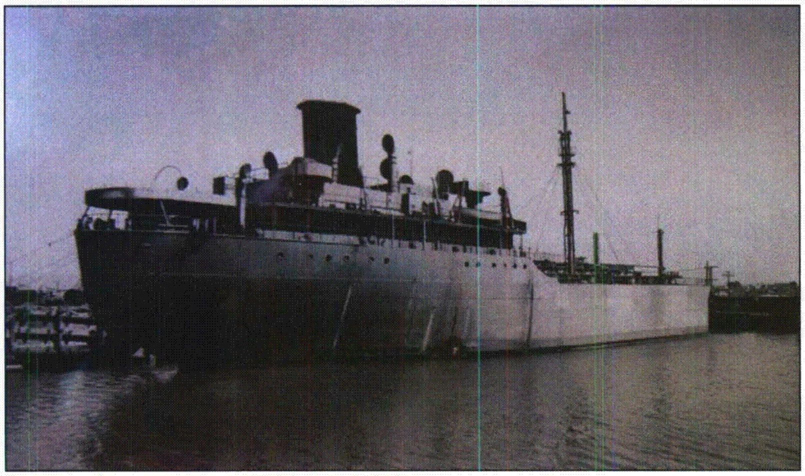

Figure 4. The stern section of the *Donbass III* docked in Eureka (Courtesy of PG&E)

The *Donbass III's* contribution to the grid helped with the power shortage in the short run, but the Humboldt region still needed more. In 1952 the company installed a 110 kV transmission line from Cottonwood to Eureka, adding to the two existing parallel lines from Junction City, one 60 kV, the other 110 kV. Even with this new transmission line, the Eureka Division had difficulty providing a reliable power supply. The transmission lines across the Trinity Alps were regularly damaged in winter storms, which resulted in power shortages and outages. In the event of line damage, the *Donbass III* became the main supplier of power. Customers were often asked to unplug unnecessary electrical appliances or equipment, and lumber mills without their own systems came to a standstill. In an era of post-war growth when the population of the Humboldt Division service area increased by nearly 150% and energy consumption by 600%, PG&E realized that it could no longer rely on the long transmission lines and salvaged World War II-era tankers to power the Humboldt region. The company needed to provide for the Humboldt region so it could become responsible for producing its own energy, thus the Humboldt Bay Power Plant became a necessity.[8]

2.3 *Building Units 1, 2, and 3*

In 1952 PG&E secured 147 acres on Buhne Point on which it planned to build a new complex, the Humboldt Bay Power Plant. The plant was to house two 25,000 kW steam generating units. The first unit was to be completed in 1956 and the second unit two

[8] *Humboldt Standard*, December 20, 1952; January 15, 1952; March 24, 1952; October 12, 1956.

years later. Dan Villa, PG&E's Humboldt Division manager, stated that Buhne Point was chosen as the plant site based on four advantageous factors:

> ... (1) a plentiful supply of cold water for condensing the steam; (2) sufficient room for future plant expansion; (3) a favorable route for transmission lines from the new plant to Humboldt substation, east of Eureka, tying the plant into the company system; and (4) adequate berthing for ships delivering the plant's fuel oil.[9]

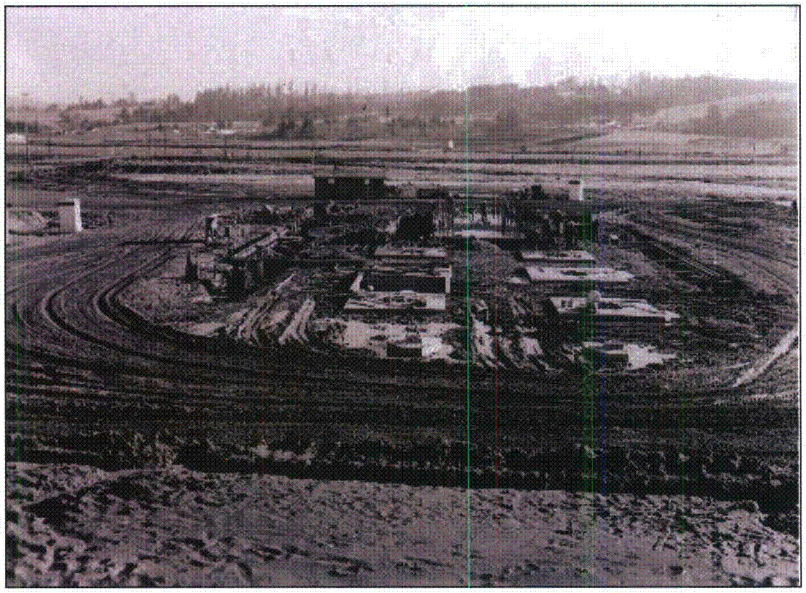

Figure 5. HBPP site construction (Courtesy of PG&E)

Steam generating units were chosen for the plant based on the location of the site and power companies' preference for steam over other electrical generating sources. In fact, by 1950 steam turbine units were based on well-established proven technologies. British designer Sir Charles Parsons built the first steam turbine-generator in 1884. Almost immediately others began making improvements upon his original concept, but the earliest steam generating plants were little more than steam engines converted to drive a generator rather than a locomotive. By the beginning of the twentieth century, engineers designed steam turbines to replace the original steam engine power plants. Aegidius Elling of Norway is credited with creating the first applied method of injecting steam into the combustion chambers of a gas turbine engine in 1903-04 and within a relatively short time, the technology and capacity of these engines to supply power and electricity grew by leaps and bounds. These advances soon brought electricity to a wide range of industrial and domestic applications; however, the materials needed to withstand the high temperatures of modern turbines were not available in the early stages of the

[9] *Humboldt Standard*, February 12, 1952.

technology. Improvements in steam turbine engines advanced throughout the 1920s and 1930s, leading to a generation of more efficient turbine power plants by the 1950s. During this time, utilities also closed or replaced many of the older steam-electric plant generating units and constructed more modern units.[10]

Steam power generation was part of California's power production throughout the twentieth century, although the role of steam generation diminished considerably during the pre-World War II era when huge hydroelectric generating plants came on line throughout the state. As early as 1920, hydroelectric power accounted for 69% of all electrical power generated in California. In 1930, that figure had risen to 76%; and by 1940 hydroelectric sources provided 89% of California's electricity. Rapid construction of steam-powered electric generating units, however, accounted for most of the new generation capacity in the state after World War II. By 1950, hydroelectricity accounted for only 59% of the total power generated, falling to 27% in 1960. Some new hydroelectric plants were built during the 1960s, chiefly associated with federal and state water projects, but by 1970, hydroelectric plants accounted for only 31% of all electricity generated in California.[11]

These statistics, however, tend to obscure the work of PG&E and Southern California Edison (SCE), California's largest electrical utility providers, which both built large-scale steam generation plants as early as the 1920s. James Williams, a historian of energy policies and practices in California, noted that the decision by PG&E and SCE to build steam plants may be attributed to several converging trends in the mid- to late-1920s. First, a persistent drought in California caused the major utilities to begin to question the reliability of systems relying so heavily upon hydroelectricity. This drought began in 1924 and continued, on and off, for a decade. At about the same time, new power plants on the East Coast (where steam had always played a more important role than in California) achieved far greater efficiencies than had previously been possible. For example, between 1900 and 1930, the fuel efficiency of steam plants, measured in kilowatts per barrel of oil, increased more than nine-fold. In addition, new natural gas lines were completed which could bring new supplies to both Northern and Southern California in the late 1920s, tapping large reserves in the San Joaquin Valley. Natural gas

[10] Heinz Termuehlen, *100 Years of Power Plant Development: Focus on Steam and Gas Turbines as Prime Movers* (New York: ASME Press, 2001), 11, 21-28; Douglas Stephen Beck and David Gordon Wilson, *Gas Turbine Regenerators* (New York: Chapman & Hall, 1996), 30; William A. Myers, *Iron Men and Copper Wires: A Centennial History of the Southern California Edison Company* (Glendale, CA: Trans-Anglo Books, 1984), 8.

[11] James C. Williams, *Energy and the Making of Modern California* (Akron, Ohio: University of Akron Press, 1997), 374.

has played an important role in steam electric power generation in California since that time.[12]

The confluence of these various factors – a drought, new steam generator technologies, and new supplies of natural gas – induced PG&E, SCE, and other utilities to begin construction of large steam plants during the late 1920s and early 1930s. In 1929, the Great Western Power Company (absorbed by PG&E in 1930) built a large steam plant on San Francisco Bay, near the Hunters Point shipyard, fitted with two 55 mW generators.[13] PG&E also built a steam plant in Oakland in 1928, called Station C, and a few years later a PG&E vice-president for engineering wrote: "under the circumstances which now prevail, it is natural to question the future of hydro in California."[14]

It was in response to the demands of post-World War II growth in California that PG&E built new steam generation plants throughout the state. Wartime increases in population continued after the end of hostilities and general statewide economic expansion spurred rapid growth in the residential, commercial, and industrial sectors. The need to generate power was imperative and PG&E expanded its systems along with the rest of California's energy industry. Between 1946 and 1953 the company invested $1 billion in energy infrastructure and generating facilities. Because most of the more favorable hydroelectric sites in California had already been developed, and the cost of steam generating facilities had been reduced by technological developments in design and abundant natural gas resources, steam plants became the more favorable option. Steam turbine power plants were cheaper and quicker to build than hydroelectric plants, and utility companies continued the move away from hydroelectricity during this period. Steam turbines became the generator of choice. Such plants conserved water and kept costs down for the business and the consumer.[15]

PG&E steam generation plants built during the postwar period relied upon proven technologies and were constructed quickly and inexpensively relative to earlier plants. In a detailed article in 1950 in *Civil Engineering*, PG&E Chief Engineer I.C. Steele summarized the design criteria that went into construction of four major steam plants

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[12] Williams, *Energy and the Making of Modern California*, 278; Charles M. Coleman, *PG&E of California: The Centennial Story of Pacific Gas and Electric Company* (New York: McGraw-Hill, 1952), 306.

[13] This plant still exists. It was fitted with new units in 1948, at the same time that the Kern Power Plant was being constructed (Coleman, *PG&E of California*, 298).

[14] "1928 Steam Plants Account for 45 Percent of New Generating Capacity," *Electrical West* (February 2, 1929), 80-81; R.W. Spencer, "Cooling Water For Steam Electric Stations in Tidewater, "*Transactions of the American Society of Civil Engineers* 126 (1961): 294, 300; Williams, *Energy and the Making of Modern California*, 279.

[15] Myers, *Iron Men and Copper Wires*, 200; Williams, *Energy and the Making of Modern California*, 277-78, 282-83; Charles M. Coleman, *PG&E of California,* 331.

the company had under construction at that time, at Moss Landing, Contra Costa, Kern, and Hunters Point in San Francisco. These plants had much in common with each other and with other steam plants under construction in the state. The site selection criteria were the same in all cases: locations close to load centers to reduce transmission costs; easy or efficient access to fuel supplies; being near a water supply; on inexpensive land; and on geological formations that could provide a good foundation. By the mid 1950s, Walter Dickey, an engineer from Bechtel, examined recent design innovations in an article prepared for *ASCE Transactions*, that improved the economics of steam plant construction even more. These plants, he argued, could be built economically by minimizing the structural material, chiefly by creating semi-outdoor turbo-generator units. Furthermore, virtually all of these plants were designed to be expanded if market conditions warranted, and most of them were.[16]

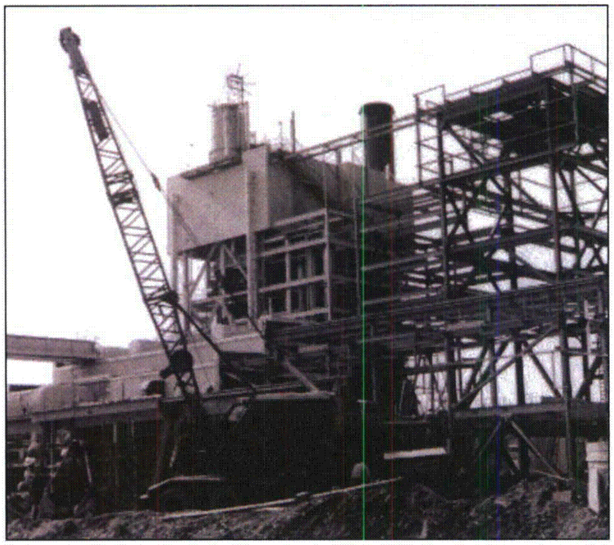


Figure 6. Construction of Unit 2 (Courtesy of PG&E)

The decades between 1950 and 1970 were years of expansion of steam generating capacity for PG&E, SCE, and other utility companies. PG&E operated 15 steam electric plants in California in 1950, and during the following decade added several new plants and expanded older ones. Chief among these were the Kern plant (1948-50), Contra Costa (1951-53), Moss Landing (1950-52), Pittsburg (1953-54), Morro Bay (1955), Hunters Point (addition 1958), and the subject of this report, Humboldt Bay (1956-58). By the late 1970s, there were more than twenty fossil fuel steam generating plants in

[16] I.C. Steele, "Steam Power Gains on Hydro in California," *Civil Engineering* (January 1950): 17-21; Edgar J. Garbarini, "Design Saves Construction Dollars on Contra Costa Power Plant," *Civil Engineering* (May 1953): 31-33; Walter L. Dickey, "The Design of Two Steam Electric Plants," *ASCE Transactions* (1956): 253-273.

California owned by various power companies and clustered around San Francisco Bay, the greater Los Angeles area, and in San Diego County, along with a few interior plants in San Bernardino County, Riverside, Imperial Counties, a few on the Central Coast, and the HBPP complex in Humboldt County.[17]

Most of the oil- or gas-fired steam plants currently in use in California were installed in the period from about 1950 through 1970. After 1970, the major utilities began to look for alternative energy sources, ranging from nuclear power to wind, geothermal, and other "green" energy sources, other than traditional thermal or hydroelectric systems. Despite these efforts, however, fossil fuel steam generation remains the backbone of electrical generating capacity in California and there are currently 34 steam turbine power plants in California of a variety of ages and locations.[18]

When the steam turbine units at the Humboldt Bay Power Plant complex were brought on line, a much greater quantity of power was produced in the area. Of course, PG&E retained the transmission lines that had been bringing electricity to the area since 1904. The existing lines that connected the region to PG&E's plants in the east were to remain in use. In the event of line failure, the new power plant would increase its output to compensate for the loss until it was restored (see Figure 7). The power plant was intended to exclusively supply the Humboldt pocket with power, and only if there was an excess was any of it to leave the service area along the Cottonwood transmission line.[19]

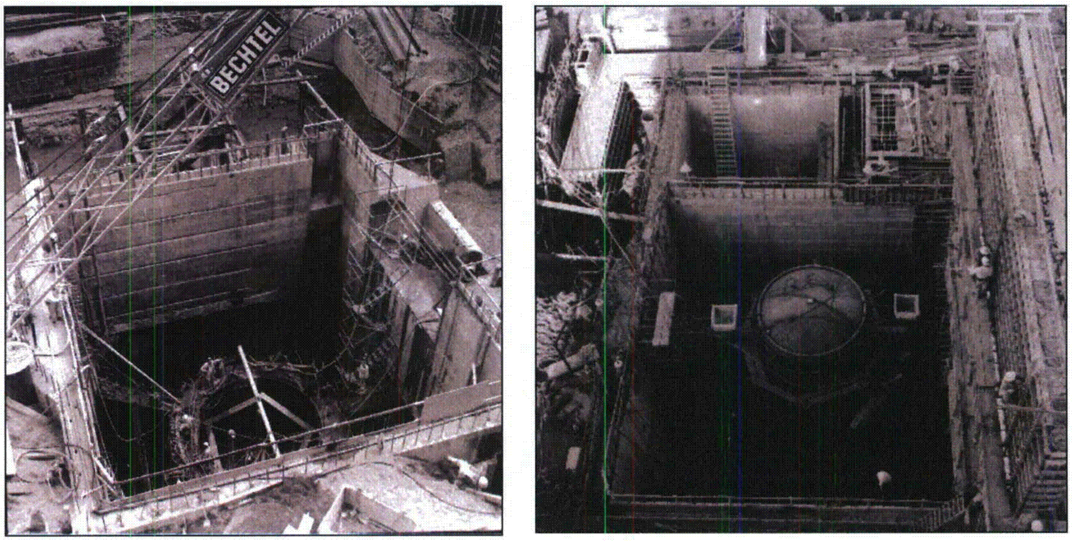
At the plant's dedication ceremony of Unit 1 on October 12, 1956, N.R. Sutherland, President of PG&E, was already expressing excitement in the company's pursuit of atomic energy. He revealed that the Humboldt Bay Power Plant had been considered as an atomic plant, but the cost to the customer would have been too great at that time. Only 16 months later Sutherland reported that the cost barrier had been broken and that PG&E planned that the Humboldt Bay Power Plant was to be the first privately owned

[17] Annual Reports of the Southern California Edison Company, various years; Spencer, "Cooling Water For Steam Electric Stations in Tidewater," 280-302; Steele, "Steam Power Gains on Hydro in California," 17-19; Dickey, "The Design of Two Steam Electric Plants," 253-255; "Haynes Steam Plant Will Grow With Demand," *Southwest Builder and Contractor* (October 12, 1962): 24-27; Williams, *Energy and the Making of Modern California*, 257.

[18] The US Department of Energy retains figures on the fuel type for all electricity used in the state. In 2005, natural gas-fired generators were responsible for 36% of all electricity used in the state, compared with 20% for hydroelectricity. Nuclear plants accounted for 19% of the total. "Green" sources accounted for 20%. http://apps1.eere.energy.gov/states/energy_summary.cfm/state=CA.

[19] *Humboldt Standard*, October 12, 1956; Richard MacKenna, interviewed by Rand Herbert, Eureka, Ca., May 28, 2009.

nuclear power project in the nation. The project proposed a 60,000 kW boiling water atomic power unit to be completed by 1962.[20]



Figures 8 & 9. Below grade construction of Unit 3 (Courtesy of PG&E)

Boiling water reactors (BWR) and pressurized water reactors (PWR) are the two most common types of reactors used in atomic plants. A BWR reactor, the kind used in the HBPP, is the simpler of the two. Inside the reactor vessel is an atomic core that creates heat. As purified water moves up the core, a steam and water mixture is created. The steam and the water are then separated so only steam enters the steam line that is connected to the turbines. The steam turns the turbine generator and electricity is produced. Any extra steam is sent to a condenser where it turns back to water. The water is then purified and sent back into the reactor vessel.[21]

The HBPP was chosen as the site of a new atomic reactor largely for economic reasons. Humboldt's isolated location meant that high transportation costs were being added to the price of the fuel that was bought to run Units 1 and 2. If an atomic generator could be refueled less often, but produce the same amount of energy for the same or less than the cost of gas or oil, then atomic energy seemed like a smart economic move. Another deciding factor in choosing HBPP for an atomic reactor was to help supply the expected

[20] *Humboldt Standard*, October 12, 1956; February 19, 1958.
[21] For a description of PWRs, visit the NRC's website at http://www.nrc.gov/reactors/pwrs.html.

power demand. Based on the population growth between 1940 and the late 1950s, energy use was estimated to increase in to 155,000 kW by 1960.[22]

In developing their own atomic plant, PG&E used their involvement in the nation's first privately-funded nuclear plant at Vallecitos in Alameda County as a case study. Vallecitos was a joint project between General Electric, Bechtel Corporation and PG&E to make the first nuclear power plant. PG&E helped fund the project, provided the turbine, and distributed the power generated by the plant into the grid. The plant served as a research, learning, and training facility for atomic plants. PG&E was confident in its knowledge of harnessing atomic energy and decided to build its own plant.

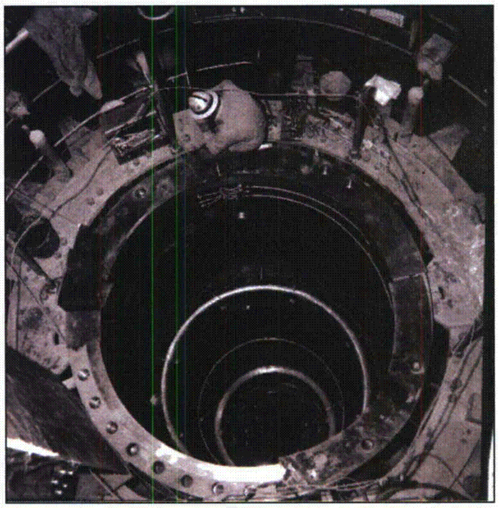


Figure 10. The underground chamber of Unit 3.

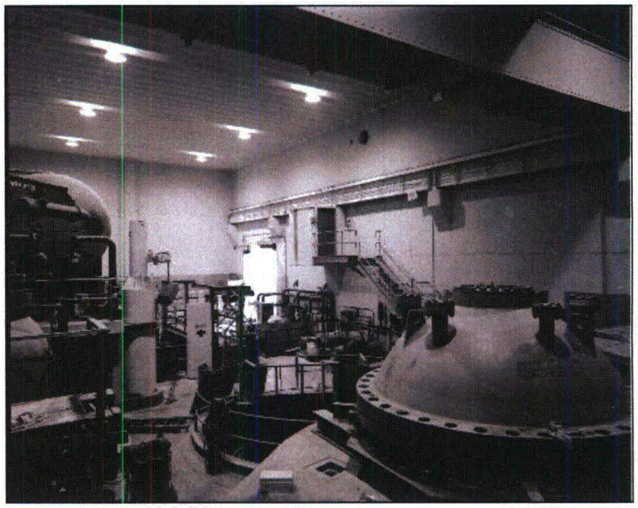


Figure 11. Inside the Unit 3 building (Courtesy of PG&E)

PG&E put its engineering department to work on designing the plant with help from General Electric engineers who also worked on the Vallecitos plant. The engineers turned away from the Vallecitos design that was aboveground with a large concrete container dome. Instead, the engineers developed an underground design called a pressure suppression system that used less concrete, had fewer seams, was less visible, and was partially filled with water to absorb any radioactive condensation from steam in the event of an accident. The container for the reactor was 85 feet underground, had four feet thick walls, a 72 ton concrete and steel shield plug on top of the reactor, and a 250 foot tall stack for the diffusion of ventilated air, other gases, and minor radiation. All of the new design elements created a cheaper, yet safer, facility. PG&E submitted their

[22] PAR Environmental Services, Inc., *Cultural Resources Study for the PG&E Humboldt Bay Power Plant, ISFSI Licensing Project*: *Revision 1* (Sacramento, CA: Par Environmental Services, Inc., 2003), 19.

plans to the California Public Utilities Commission and the Atomic Energy Commission in late 1959 and construction began after approval in November 1960.[23]

Construction of the atomic reactor, called Unit 3, began in early 1963. With its completion, the Humboldt Bay Power Plant became the nation's first privately owned nuclear plant that was financed, built, and operated by one company. It was also the first plant to be built to compete with the cost of fuel or natural gas burning steam plants.[24] In March of 1963, Unit 3 was loaded with 17 tons of uranium dioxide, three years worth, which was estimated as having the same power potential as 750,000 tons of coal. That same year PG&E reported that it had used eight million barrels of oil and 170 billion cubic feet of natural gas to run twelve conventional steam electric generating plants. Months were needed after the unit was loaded with uranium to pass inspections and have time for the plant to begin producing enough steam power for commercial use. By August, it had reached that point, a month before the dedication ceremony on September 23, 1963.[25]

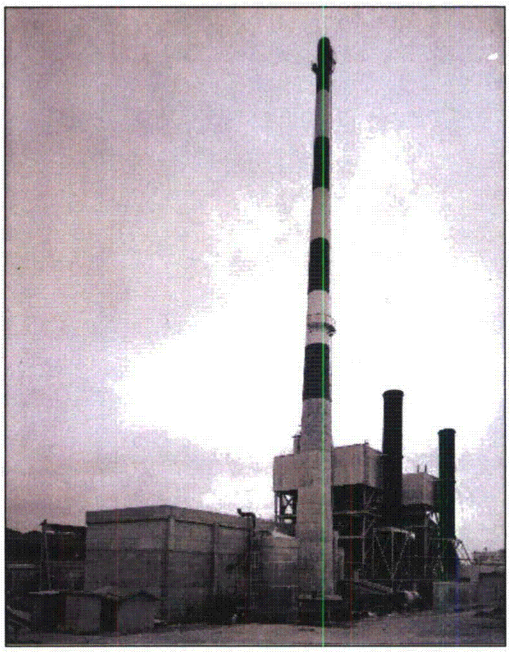


Figure 12. Completed Unit 3 in foreground; Units 1 and 2 are in the background. The tall stack has been demolished. (Courtesy PG&E)

[23] PAR, *Cultural Resources Study for the PG&E Humboldt Bay Power Plant* 20; *Humboldt Standard*, September 23, 1963; January 23, 1961; MacKenna, Richard, Interviewed by Rand Herbert, Eureka, California, May 28, 2009.
[24] *Humboldt Standard*, October 25, 1962; September 23, 1963.
[25] *Humboldt Standard*, March 13, 1963; October 25, 1962; September 23, 1963.

At the dedication ceremony, PG&E President Robert H. Gerdes averred that atomic energy was going to be the source of cheap energy that would enable California to grow and prosper in the years to come. He predicted that after 1970 nuclear plants would become the "conventional" power plants of the day. Humboldt Bay Power Plant's nuclear unit was to be the catalyst for this change because, Gerdes stated,

> It embodies design innovations which improve the efficiency and add to the security of the plant, while reducing the cost. It is history-making in many accounts which you will hear about today and for some time to come.[26]

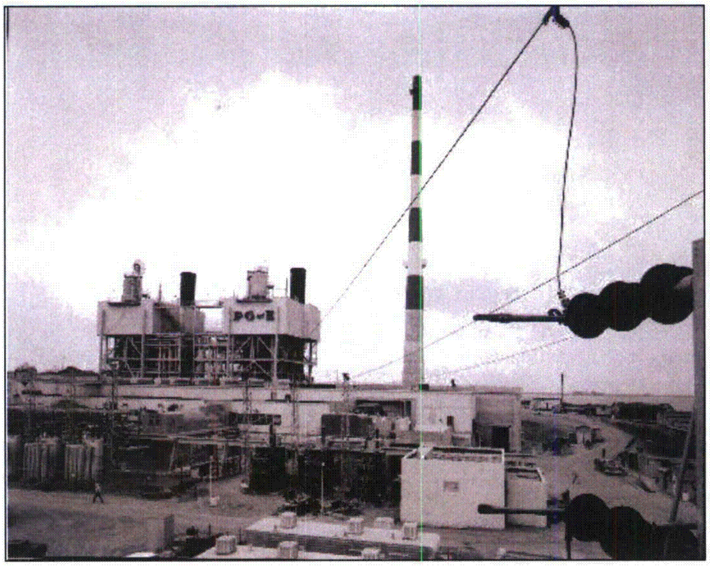


Figure 13. Units 1 & 2 at left, Unit 3 at right. (Courtesy PG&E)

After being online for 18 months, Unit 3 had produced 428,506,000 kW hours of electricity and was so reliable that the AEC allowed the plant to increase its capacity from 52,000 kW to the full capacity of 72,000 kW two years later.[27]

In 1976, geological surveyors discovered that the Little Salmon Fault near the plant, previously reported as dormant, was active. In response, Unit 3 shut down in July for a year long, $30 million seismic retrofit and for routine refueling. As Unit 3 was about to be brought online again, the Nuclear Regulatory Commission informed the PG&E that more seismic studies were needed before Unit 3 could be restarted. In the meantime, the disaster at Three Mile Island occurred and the NRC placed new guidelines for atomic plants. PG&E's evaluation of the new guidelines and standards concluded that at least

[26] *Humboldt Standard*, September 23, 1963.
[27] PAR, *Cultural Resources Study for the PG&E Humboldt Bay Power Plant,* 30.

$300 million was needed for improvements, and decided in 1983 to decommission Unit 3.[28]

Norman R. Sutherland, President of PG&E from 1955 to 1963, dedicated the HBPP to "the service of the public, to the advancement of the atomic age, and to the progress and prosperity of Humboldt County," but in terms of population growth, the Humboldt Bay pocket did not grow as anticipated after completion of Unit 3 and during its operating life.[29]

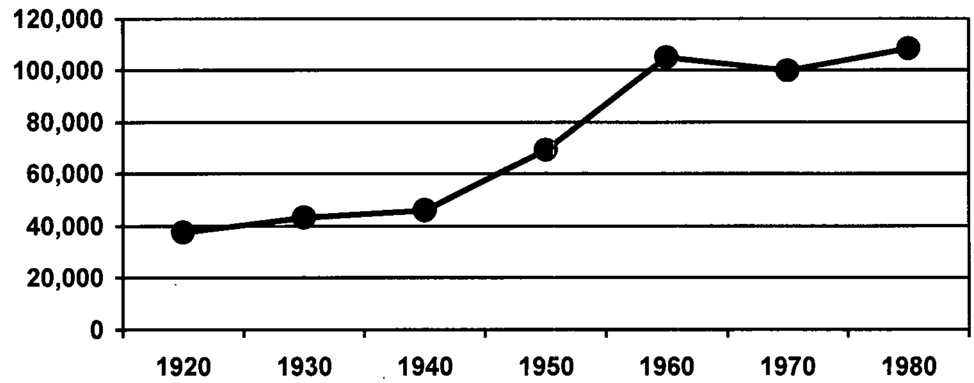


Figure 14. Population Growth of Humboldt County (Source: U.S. Census Bureau)

2.4 *HBPP Operations*

Operating the HBPP, with two fuel-fired units and one nuclear system, was different than operations at other PG&E plants, which were either standard fuel fired or, in the case of Diablo Canyon, nuclear alone. In May 2009, JRP interviewed veteran plant operators Rod Nelson and Richard "Mac" McKenna to help understand these differences, and to learn how the plant was operated on a day-to-day basis.[30]

Mr. Nelson, a 13 year veteran of plant operations, advised that Unit 3 ran at full load as much as possible, while Units 1-2 were often at minimum load, but because of their design for "quick pick up" could balance the fluctuations in the pocket's load, including that coming in from PG&E's Cottonwood area facilities on the pre-HBPP transmission line. He explained that the quick pick up systems used in Units 1 and 2 provided for

[28] PAR, *Cultural Resources Study for the PG&E Humboldt Bay Power Plant,* 33.
[29] *Humboldt Standard,* January 23, 1961.
[30] Interviews with Rod Nelson and Richard McKenna, May 28, 2009.

oversized boilers, operating under pressure, so that in the event of sudden demand, they could respond with a rush of power. Standard fuel-fired plant boilers were sized smaller in proportion to output, and made to provide more constant pressures and loads. When sudden drops in the system supply required more power, the boiler throttle valves would open, with the resulting reduction in pressure producing a flash of steam and a short-term boost in power. Both he and Mr. McKenna agreed, however, that use of the quick pick up system was unrelated to Units 1 and 2 operating in conjunction with Unit 3. The three units' coordinated operations (one nuclear and two fuel fired) did not require use of a quick pick up system; rather, it was the varying local load that led to its use, along with reliance on two transmission lines which were unreliable owing to effects of weather, fire, and rough terrain.

Mr. Nelson summarized that Units 1-2-3, combined with the Cottonwood – Humboldt Transmission Line (and MEPS / Mobile Emergency (Generators) Power Systems after Unit 3 was decommissioned) all acted to balance loads and provide a reliable supply. Mr. McKenna observed that the units provided power to residential customers, businesses, and government entities. Large industrial demand, such as sawmills, generally had their own generation systems, often fed by mill waste. He also noted that when Unit 3 was running, either Unit 1 or 2 would be idle. Unit 3 ran at a consistent output of about 65 mW. Power that was not absorbed within the local load pocket was sent east to Cottonwood for use elsewhere in the grid.

In terms of operations, McKenna noted that Unit 3 was a nice unit to operate; it perked along with basic supervision. On the other hand, Units 1 and 2 had lots going on, and needed more "hands on" attention. He observed that with Unit 3, one made rounds; with Units 1 and 2, constant monitoring was required.

3. Historic themes and contexts

Based on the historic context (see above, Section 2), the key historic themes in association with which the Humboldt Bay Power Plant gains significance and the scope (topical and geographical) of significance at the national, regional, and local levels are:

- Planning and development of reliable power facilities for the Humboldt Load Pocket, replacing reliance on old or outdated / makeshift systems and long transmission lines with a modern facility with dual fuel (oil or gas) and nuclear powered generators

- Construction of California's first commercial boiling water nuclear reactor / generator
- Construction of a power generator complex marrying oil / gas fired boilers with a nuclear facility to provide reliable power

It is these themes or values that are to be mitigated by the proposed mitigation plan.

4. Recommended Mitigation Measures

Mitigation measures in this section address substantial adverse impacts caused by Units 1 – 3's demolition within the Humboldt Bay Power Plant (HBPP) complex. Considerations and recommended mitigation measures are presented below, beginning with those mitigation activities and specifications that would be conducted for the buildings and structures. Mitigation measures will be finalized based on input received from interested parties during consultation.

4.1 Professional Standards

All activities regarding historical architectural resources and historic preservation carried out as part of this project should be carried out by, or under the direct supervision of, persons meeting the Secretary of the Interior's professional qualifications standards (48 CFR 44738-9) in these disciplines.

4.2 Recordation to Historic American Buildings Survey / Historic American Engineering Record, to Level II standards

Recordation of the complex's major components to HABS / HAER standards will be implemented as a fundamental mitigation measure. PG&E has recorded and documented the important engineering features of Units 1 – 3 in accordance with the Level II recordation standards of the Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) program and the recorded documentation will be submitted as a donated project. This level of recordation will include:

- archival reproduction of any existing historic images of the resources;

- archival reproduction of any existing maps, sketches, or drawings of the resources; in some cases scanned images are all that survive and will be used to generate the best possible images;
- production of measured architectural plans and drawings of the resources; in some cases scanned images are all that survive and will be used to generate the best possible images;
- production of large-format photographs of exterior and interior views of the resources, and views of the setting of the resources, including relationship to landscape features and adjacent buildings not directly affected by the project;
- preparation of a narrative history and description of the property based on the narrative included in the evaluation of the property (Appendix A), and City and County of Humboldt survey(s) of similar properties, if any.

If original plans cannot be photographically reproduced, PG&E will provide copies from which good quality images can be prepared. The original archival set of recordation documents and original photographic prints will be submitted to the Humboldt County Historical Society (or its designee) and / or the Humboldt Room at CSU-Humboldt Library. Archival quality photocopies of the documentation set, with binding, will be provided to local repositories, including Humboldt County libraries (Humboldt branches), Humboldt Public Library's History Center; and California State University - Humboldt Library – Special Collections. PG&E will ensure that this recordation documentation is prepared prior to carrying out any other mitigation measures and would make the content of the document available for other mitigation measures, such as the preparation of interpretive material.

PG&E will donate to the NPS HABS/HAER program in Washington DC a copy of the HABS/HAER recordation project, and with the State of California Office of Historic Preservation if this mitigation measure is to be carried out under CEQA only.

4.3 *Mitigation Activities based on HABS/HAER recordation*

PG&E will consult with interested parties about their intention of displaying permanent or temporary interpretive exhibits describing the history of HBPP and its units. These exhibits or publications can be based upon the materials collected and text generated during the HABS/HAER project. If consultation results in agreement between the project proponent and these parties concerning the nature and extent of the exhibits, PG&E will produce and install exhibits that could include the following:

- Display panels - mounted in a case in an area readily available and frequented by the public, such as the lobby or other public area within the new power complex administrative building, presenting the history of HBPP and specific information on the buildings demolished, and their place in HBPP history. The display can be modified and added to over time. These panels can also be loaned to local museums for specified periods for exhibition.

- Preparation of a trifold brochure - with pictures and text based on the display panels -- will be placed on a stand or other holder, and kept filled for a specified period of time (set by the university). The brochures should be located in the vicinity of the display panels.

- Preparation of a book-length, heavily-illustrated, large format history of PG&E and its predecessor companies in the Humboldt County area, focusing primarily on the Humboldt Bay Power Plant. This book would be donated to local libraries, and made available to the public and former employees.

- An electronic version of the HABS/HAER report will be hosted on the PG&E website, or other website as appropriate, for a specified period.

4.4 *Other mitigation measures*

- PG&E will provide a collection of documentary and graphical materials related to HBPP and the history of power development in the Humboldt Load Pocket, to be arranged into a research file housed at the Humboldt County Historical Society or the Humboldt Room at California State University - Humboldt. This would include: 1) the HABS/HAER report; 2) previous cultural surveys and reports, 3) business records, operations reports, or any materials donated by PG&E or other parties, comprised of either original documents or copies (paper or scanned), 4) information on construction and operation of Station B and *Donbass III* held by PG&E. For Station B and other earlier, information related to activities of predecessor companies acquired by PG&E should be included.

- Donation of artifacts. PG&E will arrange to salvage artifacts of general interest for donation or display. These might include construction / explanatory models, equipment nameplates, dials or controls, interesting or attractive architectural features (such as the surplus ship doors used in Unit 3, operational signage, etc.), and other such items. Large objects could possibly be mounted near the informational marker with explanatory plaques; smaller items could possibly be donated to local museums / historical societies, or displayed in public areas of the administration building in display cases.

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